CHARLES UNIVERSITY IN PRAGUE

Faculty of Physical Education and Sport

Department of Physiotherapy

Case Study of Physiotherapy Treatment of a Patient after Total Hip Replacement

Bachelor's thesis

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Prague, August 2016

Abstract

Title of thesis: Case Study of Physiotherapy Treatment of a Patient after Total Hip Replacement.

Work placement: Institute of Rheumatology (Revmatologický ústav), Prague

Summary:

The goal of this bachelor's thesis is to present a theoretical and practical view of coxarthrosis, also known as hip osteoarthritis, and its treatment. It consists of a theoretical part and a case study. The theoretical part consists of the anatomy, biomechanics and kinesiology of the hip joint, and characteristics of coxarthrosis and its treatment. The case study is based on a 64-year-old female patient who underwent total hip replacement of the left hip joint. It consists of anamnesis, initial kinesiological examination, rehabilitation plan, therapy progress, final kinesiological examination, effect of therapy, reflexion on therapy and conclusion. The methods used during the therapy sessions with the patient were all non-invasive. A combination of manual techniques and rehabilitation exercises was used with the aim to help the patient recover and become as self-reliable in the activities of daily living as possible.

Keywords: hip joint, rehabilitation, coxarthrosis, osteoarthritis, exercises, range of motion

Abstrakt

Název bakalářské práce: Kazuistika fyzioterapeutické péče o pacientku po totální endoprotéze kyčelního kloubu.

Pracoviště: Revmatologický ústav, Praha

Souhrn:

Cílem této bakalářské práce je představení teoretického a praktického pohledu na koxartrózu, známou rovněž jako osteoartritida, a její léčbu. Skládá se z teoretické části a kazuistiky. Teoretická část zahrnuje anatomii, biomechaniku a kineziologii kyčelního kloubu, a rovněž charakteristiku koxartrózy a její léčbu. Kazuistika se týká 64-leté pacientky, která podstoupila totální endoprotézu kyčelního kloubu levé kyčle. Sestává z anamnézy, úvodního kineziologického vyšetření, rehabilitačního plánu, postupu terapie, závěrečného kineziologického vyšetření, efektu terapie, úvahy o terapii a závěru. Všechny metody použité během terapeutických sezení s pacientkou byly neinvazivního charakteru. Byla uplatněna kombinace manuálních technik a rehabilitační cvičení s cílem pomoci pacientce zotavit se a stát se v co nejvyšší možné míře soběstačnou v každodenních činnostech.

Klíčová slova: kyčelní kloub, rehabilitace, koxartróza, osteoartritida, cvičení, rozsah pohybu

Declaration

I declare that I have written this bachelor's thesis myself. All information and clinical procedures which are presented in it are a result of the knowledge I acquired during my studies at the Faculty of Physical Education and Sport, Charles University in Prague, and the literature listed under the section "Reference list". All references to the literature used have been marked to the best of my ability.

Daniela Popov

Prague, August 2016

Acknowledgements

I am greatly indebted to my wonderful supervisor PhDr. Tereza Nováková, PhD. She patiently supervised the writing of this thesis and offered valuable suggestions on how to improve it. In addition to this, she was available for consultation even during the summer holidays, which is something I appreciate immensely.

I am thankful to Charis Karaliotas, Bc. for his professional and gracious attitude as well as help and guidance during my clinical practice at the Institute of Rheumatology (Revmatologický ustav) in Prague. My gratitude also goes to Doc. PaedDr. Dagmar Pavlů, CSc. the head of the Physiotherapy Department at FTVS, for always being very helpful whenever I encountered some obstacles during my years at the faculty.

I am profoundly grateful to my dear friend Sarah Vaughan, an English teacher, who proof-read my thesis and made sure language infelicities were removed from it.

I also appreciate the support, help and friendship of my classmate Mona Skjaanes. My thanks go to other classmates as well. They made my study years brighter and more fun than what they would have been without them.

Finally, I cannot even begin to express gratitude to my incredible parents, who provided me with manifold support and continuous encouragement throughout my years of study and through the process of writing this thesis. This journey would have never taken place without them.

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1. Introduction

In my bachelor's thesis, I endeavoured to present both a theoretical and practical view of coxarthrosis and its treatment. In the theoretical part, the anatomy, biomechanics and kinesiology of the hip joint, as well as characteristics of coxarthrosis and its treatment are presented. The anatomy section considers the hip and thigh area from the perspective of the corresponding bones and muscles, nervous and blood supply and lymphatics. A short section on biomechanics of the hip joint follows. The hip and thigh muscles are considered again in the kinesiology section, this time from the point of view of their function. After that, coxarthrosis is described in terms of its aetiology, clinical picture, criteria for making a diagnosis and surgical treatment. Lastly, the rehabilitation of patients with coxarthrosis - conservative treatment as well as treatment in the pre-and post-operative phase - is presented.

The practical part begins with an anamnesis of the patient who had been chosen for my clinical practice at the Institute of Rheumatology (Revmatologický ústav). The anamnesis is followed by the initial kinesiological examination. Posture, muscle tone, soft tissues, muscle length as well as strength, and the range of motion (ROM) of the lower extremity (LE) joints were examined. Anthropometric measurements and neurological examination were carried out likewise. Movement pattern of the hip was assessed and so was the patient's ability to perform bed transfers and activities of daily living (ADLs). After all that, a rehabilitation plan was made. In the day-to-day therapy sessions I described how the rehabilitation plan was unfolding and what progress my patient was making. Before the patient was discharged from the hospital, the final kinesiological examination was carried out. On the basis of that examination, the effect of therapy was assessed.

Since my clinical practice was not only an opportunity to practice what I already know, but also an opportunity to learn new things and reflect on that learning process, I wrote a short reflexion on therapy. In this section I mostly describe things I would do differently in the future if I had a chance to treat another patient with the same diagnosis.

2. Theoretical part

2.1 Anatomy of the hip joint

The hip or acetabulofemoral joint is a synovial ball-and socket joint. It is the articulation of the pelvic bone and the femur, (Kapanji, 1987, p. 2) or to be more exact of the lunate surface of the acetabulum and the head of femur. (Platzer, 2009, p. 198) There are several ligaments of the hip joint, which can be described as either extracapsular or intracapsular. The joint capsule is attached to the hip bone outside the acetabular lip. The extracapsular part of the neck is shorter in front than in the back. (Platzer, 2009, p. 198) Muscle groups such as the hip flexors, extensors, adductors, abductors as well as external and internal rotators (Platzer, 2009, p. 244) enable movement around three axes and in three degrees of freedom. (Kapanji, 1987, p. 2) The femoral, obturator, sciatic and the superior and inferior gluteal nerves are the main nerves innervating the region of the hip and thigh. (Lippert, 2011, p. 277) The femoral and obturator arteries along with their corresponding veins are the main blood vessels supplying and draining the blood in the hip and thigh region. (Drake, Vogl, & Mitchell, 2010, pp. 540-542) Superficial inguinal, deep inguinal and popliteal nodes maintain the lymph flow in the area. (Drake et al., 2010, pp. 542-543) In this section we will take a closer look at these categories and create a fuller picture of what the hip joint looks like from the anatomical perspective.

2.1.1 Bones of the hip joint:

The **bony pelvis** consists of: - two hip bones

- the sacrum

- the coccyx (Platzer, 2009, p. 186)

The hip bone consists of three parts, the pubis, the ilium and the ischium, which meet at the acetabulum. Below and medial to the acetabulum there is an aperture called the obturator foramen. Then there is ilium, a large plate of bone situated above and behind the acetabulum. It forms the side wall of the greater pelvis. The upper border of ilium, which

has a form of a broad ridge, is known as the iliac crest. (Singh, 2009, p. 56) The ilium has several bony projections; among them the most important ones are the anterior superior iliac spine, the anterior inferior iliac spine, the posterior superior iliac spine and the posterior inferior iliac spine. (Singh, 2009, pp. 57-58) The most anterior part of the hip bone is the pubis, which lies in relation to upper and medial part of the obturator foramen. (Singh, 2009, p. 56) The two pubic bones are joined in the midline and form the pubic symphysis. (Platzer, 2009, p. 188) The ischium is the lowest part of the hip bone as it is situated below and behind the acetabulum and the obturator foramen. (Singh, 2009, p. 56)

The sacrum is a triangular bone which is situated at the back part of the pelvic cavity, between the two hip bones. It articulates with the ilium, fifth lumbar vertebra and coccyx. (Netter, 2011, p. 332) It consists of five sacral vertebrae and the intervertebral discs between them. It has a convex dorsal surface and concave pelvic surface. Males have a longer and more curved sacrum whereas females have a shorter and broader but less curved sacrum. (Platzer, 2009, pp. 46, 48)

The coccyx or tailbone is made up of three or four vertebrae. The surface which faces the sacrum has cornua or horns, which basically consist of fused articular processes of the first coccygeal vertebra. The rest of the coccygeal vertebrae are only small, round bones. (Platzer, 2009, p. 48)

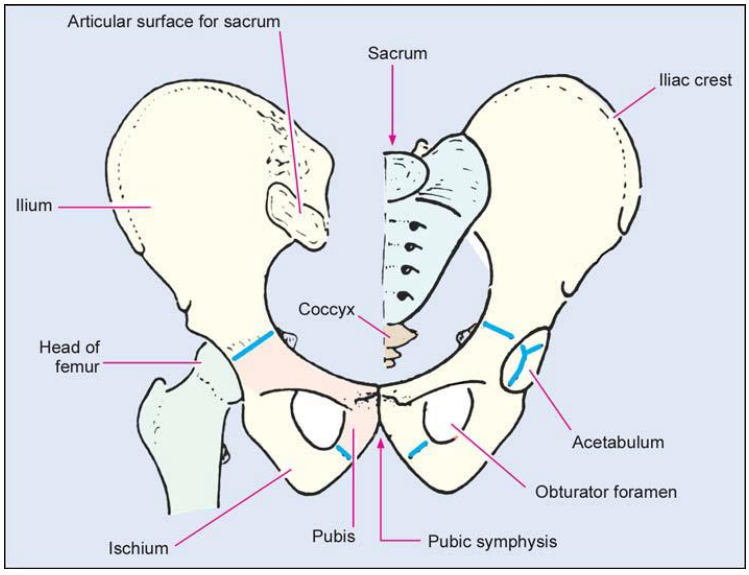


Figure 1 – Bony pelvis viewed from the front (Singh, 2009, p. 57)

The **femur** is a long bone which is composed of a shaft, neck, upper end and lower end. (Platzer, 2009, p. 192) (Singh, 2009, p. 72)

The upper end is marked by a rounded head, which distinguishes it from the lower end. The head is joined to the shaft by an elongated neck and is directed medially in order to articulate with the acetabulum of the hip bone. The anterior and posterior aspects of the bone can be distinguished if the shaft is examined: it is convex forwards and has a smooth anterior aspect, while the posterior aspect is marked by a prominent vertical ridge known as the linea aspera. (Singh, 2009, p. 72)

Apart from the head and the neck, the upper end has two important features – the greater and the lesser trochanters. (Singh, 2009, p. 72)

The lower end of the femur has two large condyles (and its corresponding epicondyles) — medial and lateral. They are different in size and are united on the anterior surface by the patellar surface. The condyles articulate with the tibia to form the knee joint. Each condyle has a large convex articular surface which covers the inferior and posterior aspect of each condyle. (Singh, 2009, pp. 75-76)

2.1.2 Ligaments of the hip joint

Ligaments have a very important function since they make sure the joint stays stable. As we have already said, the hip ligaments are divided into two groups: extracapsular and intracapsular. Extracapsular ligaments are the zona orbicularis, the iliofemoral, the ischiofemoral and the pubofemoral ligaments. The intracapsular ligament is the ligament of the head of the femur. (Platzer, 2009, pp. 198, 200)

The iliofemoral ligament arises from the anterior inferior iliac spine and the rim of the acetabulum, and is attached at the intertrochanteric line. It has a stronger transverse part and a weaker descending part. In a standing posture, when the pelvis is tilted posteriorly, the ligament's main function is to prevent the trunk from falling backwards and to keep the head of the femur pressed into the acetabulum. When the hip is flexed, the tension in the ligament is reduced and the amount of possible rotation in the hip joint is increased. This

permits the pelvis to tilt backwards into the sitting position. Lateral rotation and adduction are controlled by the strong transversal part, while the descending part limits medial rotation. (Platzer, 2009, p. 200)

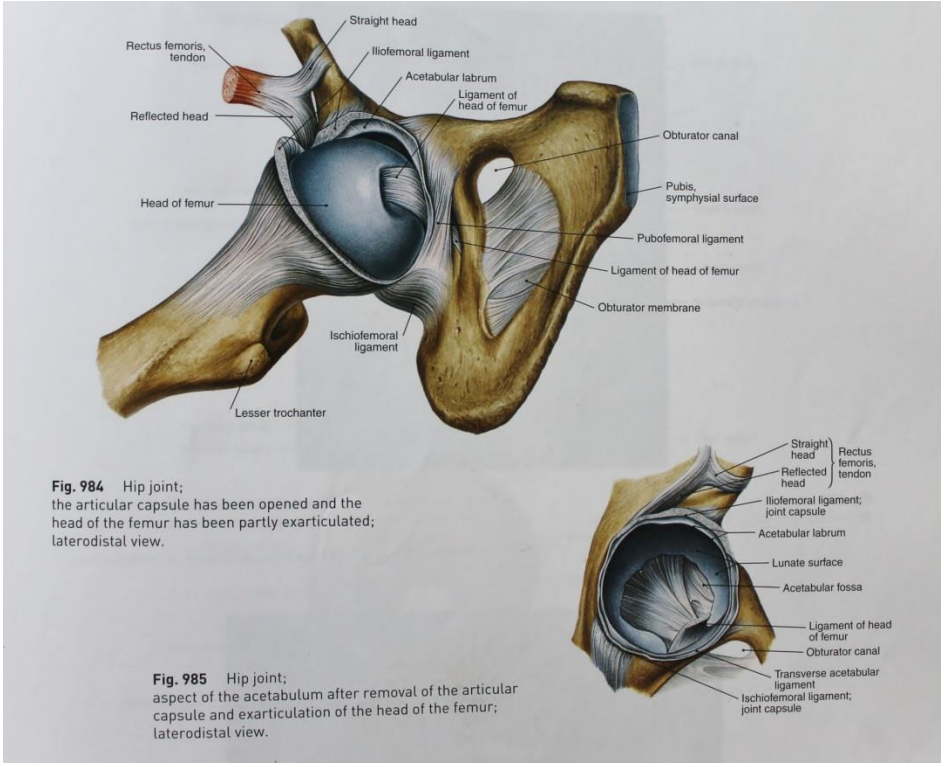


Figure 2 - Ligaments of the hip joint (Putz & Pabst, 2010)

The ischiofemoral ligament originates from the ischium below the acetabulum and is attached at the lateral part of the iliofemoral ligament. It also radiates into the zona orbicularis. Its main role is to prevent medial rotation of the thigh. (Platzer, 2009, p. 200)

The pubofemoral ligament arises from the obturator crest and obturator membrane and radiates into the capsule, more specifically into the zona orbicularis, and continues its way to the femur. Its role is to restrict movement of abduction. (Platzer, 2009, p. 200)

The intracapsular ligament of the head of the femur extends from the acetabular notch and goes to the fovea for ligament of the head. It is activated when the hip is dislocated in order to prevent an even bigger dislocation. (Platzer, 2009, p. 200)

2.1.3 Muscles of the hip and thigh

The muscles of the hip joint can be divided into several groups depending on the function they perform. Therefore, we distinguish between hip flexors, extensors, abductors, adductors and internal and external rotators (this division will be taken into account under the section Kinesiology of the hip joint). (Platzer, 2009, pp. 244, 246) But the muscles can also be divided into groups according to their positon in the body. In this sense, we speak of anterior and posterior thigh muscles as well as dorsal and ventral hip muscles (together with the thigh adductors). Let us take a closer look at which muscles belong to which group. (Platzer, 2009, p. 232)

2.1.3.1 Dorsal hip muscles

Anterior group

Psoas major (O: lateral surfaces of the twelfth thoracic vertebra, first to fourth lumbar vertebrae; the corresponding intervertebral disks; costal processes of the first to fifth lumbar vertebrae. I: lesser trochanter of the femur.) (Platzer, 2009, p. 234)

Iliacus (O: iliac fossa; region of the AIIS. I: base of the lesser trochanter of femur.) (Platzer, 2009, p. 234)

Posterior group

Piriformis (O: pelvic surface of the sacrum; margin of the greater sciatic notch. I: anteromedial aspect of the tip of the greater trochanter.) (Platzer, 2009, p. 236)

Gluteus minimus (O: gluteal area on the ala of the ilium. I: greater trochanter.) (Platzer, 2009, p. 236)

Gluteus medius (O: gluteal area of the ala of the ilium; I: greater trochanter.) (Platzer, 2009, p. 236)

Gluteus maximus (O: iliac crest; PSIS; thoracolumbar fascia, sacrum; coccyx. I: iliotibial tract; gluteal tuberosity.) (Platzer, 2009, p. 236)

Tensor fasciae latae (O: region of the ASIS. I: iliotibial tract, lateral tibial condyle.) (Platzer, 2009, p. 236)

2.1.3.2 Ventral hip muscles and adductors of the thigh

Obturator internus (O: inner surface of the hip bone around the obturator foramen; obturator membrane. I: trochanteric fossa.) (Platzer, 2009, p. 238)

Obturator externus (O: external surface of the medial bony margin of the obturator foramen; obturator membrane. I: trochanteric fossa of the femur; capsule of the hip joint. (rarely)) (Platzer, 2009, p. 238)

Gemelii (superior and inferior gemelli) (O: ischial spine; ischial tuberosity. I: trochanteric fossa.) (Platzer, 2009, p. 238)

Quadratus femoris (O: ischial tuberosity. I: intertrochanteric crest.) (Platzer, 2009, p. 238)

Pectineus (O: iliopubic eminence, along the pecten of the pubis. I: pectineal line and the proximal part of the linea aspera.) (Platzer, 2009, p. 240)

Gracilis (O: near the symphysis from the inferior ramus of the pubis. I: pes anserinus superficialis.) (Platzer, 2009, p. 240)

Adductor brevis (O: inferior ramus of the pubis; I: upper third of the medial lip of the linea aspera.) (Platzer, 2009, p. 240)

Adductor longus (O: superior ramus of the pubis. I: middle third of the medial lip of the linea aspera.) (Platzer, 2009, p. 242)

Adductor magnus (O: anterior surface of the inferior ramus of the pubis; inferior ramus of the ischium. I: medial lip of the linea aspera; tendon to the adductor tubercle of the medial epicondyle.) (Platzer, 2009, p. 242)

Adductor minimus (O: inferior ramus of the pubis. I: medial lip of the linea aspera.) (Platzer, 2009, p. 242)

2.1.3.3 Anterior thigh muscles

Quadriceps femoris, consisting of:

- Rectus femoris (O: AIIS; upper margin of the socket of the hip joint in the supra-acetabular groove. I: quadriceps tendon and the patella.) (Platzer, 2009, p. 248)

- Vastus intermedius (O: anterior and lateral surface of the femur. I: quadriceps tendon and the patella.) (Platzer, 2009, p. 248)

- Vastus lateralis (O: lateral surface of the greater trochanter, the intertrochanteric line, the gluteal tuberosity, the lateral lip of the linea aspera. I: quadriceps tendon and the patella.) (Platzer, 2009, 248)

- Vastus medialis (O: medial lip of the linea aspera. I: quadriceps tendon and the patella.) (Platzer, 2009, p. 248)

Sartorius (O: ASIS. I: crural fascia and pes anserinus superficialis.) (Platzer, 2009, p. 248)

2.1.3.4 Posterior Thigh Muscles

Biceps femoris (O: ischial tuberosity; middle third of the lateral lip of the linea aspera, the lateral intermuscular septum. I: head of the fibula.) (Platzer, 2009, p. 250)

Semitendinosus (O: ischial tuberosity. I: pes anserinus superficialis.) (Platzer, 2009, p. 250)

Semimembranosus (O: ischial tuberosity. I: “deep” pes anserinus) (Platzer, 2009, p. 250)

2.1.4 Fascias of the hip and thigh

The following are the important fascias in the hip and thigh region: iliopsoas fascia, which begins as psoas fascia and then merges with iliacus fascia, forming the iliopectineal arch; pectineal fascia, which is the pubic portion of the fascia lata; gluteal fascia, which covers the gluteus maximus; fascia lata and iliotibial tract; cribriform fascia. We also have to

mention gluteal aponeurosis, which separates gluteus maximus from gluteus medius. (Platzer, 2009, p. 254)

2.1.5 Nervous supply

The main nerves supplying the hip and thigh region are the femoral, the sciatic, the obturator, the superior and the inferior gluteal nerves as well as the anterior rami and the nerve to the obturator internus. (Lippert, 2011, pp. 277-279)

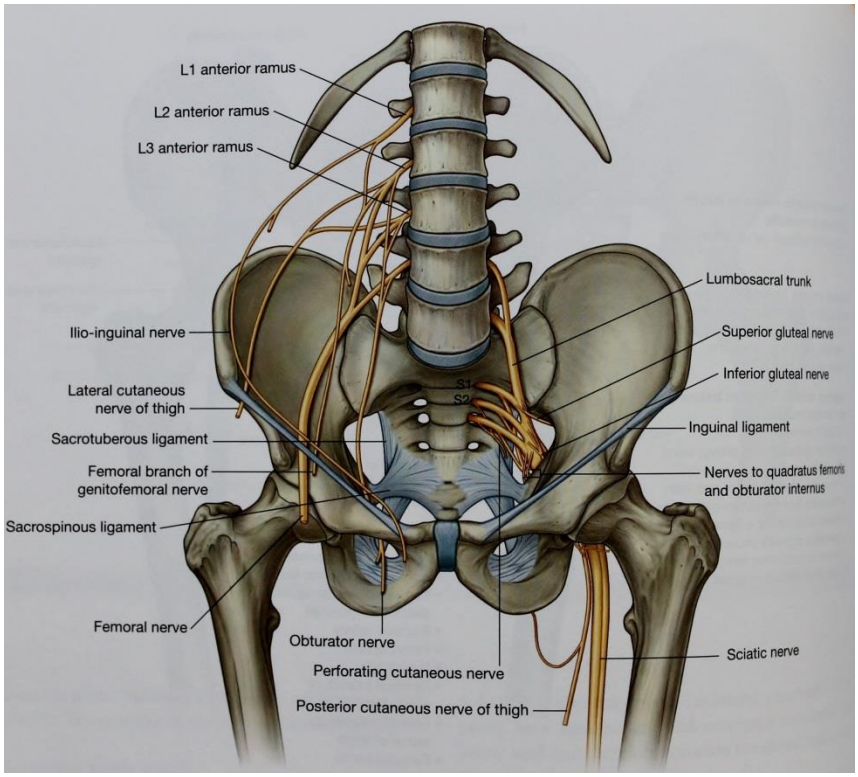


Figure 3 – Nerves of the hip area (Drake et al., 2010, p. 538)

The femoral nerve innervates the iliacus (L2, L3), rectus femoris (L2, L3, L4), sartorius (L2, L3) and pectineus muscles (L2, L3). The obturator nerve innervates the gracilis (L2, L3) the adductor muscles (longus (L3, L4), brevis (L3, L4), magnus (L3, L4)) and obturator externus muscle (L3, L4). The following muscles are innervated by the sciatic nerve: Biceps femoris (long head – S1, S2, S3), semimebranosus (L5, S1, S2) and semitendinosus

(L5, S1, S2). The superior gluteal nerve supplies gluteus medius (L4, L5, S1), gluteus minimus (L4, L5, S1) and tensor fasciae latae (L4, L5), whereas the inferior gluteal nerve supplies the gluteus maximus muscle (L5, S1, S2). The anterior rami innervate the piriformis (S1, S2) and the psoas muscle (L2, L3). The nerve to the obturator externus innervates the following muscles: the obturator internus (L5, S1), gemellus superior, whereas the gemellus inferior (L5, S1) and quadratus femoris (L5, S1) are innervated by the nerve to quadratus femoris. (Lippert, 2011, pp. 278-279) The quadratus lumborum, which is not a hip muscle strictly speaking, but is nevertheless important muscle for that region, is innervated by the lumbar plexus (T12, L1, L2, L3) (Kendall, McCreary, Provance, Rodgers, & Romani, 2005, p. 183)

2.1.6 Blood supply

The major artery supplying the lower extremity is the femoral artery, which is the continuation of the external iliac artery. Its branches supply most of the thigh and all of the leg and foot. Other blood vessels supplying parts of the lower limb are the superior and inferior gluteal arteries and the obturator artery, which are branches of the internal iliac artery. The superior and inferior gluteal arteries supply blood to the gluteal region. Branches of the femoral, inferior gluteal, superior gluteal and obturator arteries as well as branches from the internal pudendal artery of the perineum form an anastomotic network in the upper thigh and gluteal region. These anastomotic channels can provide collateral circulation in case one of the vessels is interrupted. (Drake et al., 2010, pp. 540-542)

The deep veins mostly follow the arteries (femoral, superior gluteal, inferior gluteal, and obturator). The major deep vein responsible for draining the limb is the femoral vein. The superficial veins, which are interconnected with the deep veins, are located in the subcutaneous connective tissue, draining blood into the deep veins. They form two major channels - the great saphenous vein and the small saphenous vein. (Drake et al., 2010, p. 542)

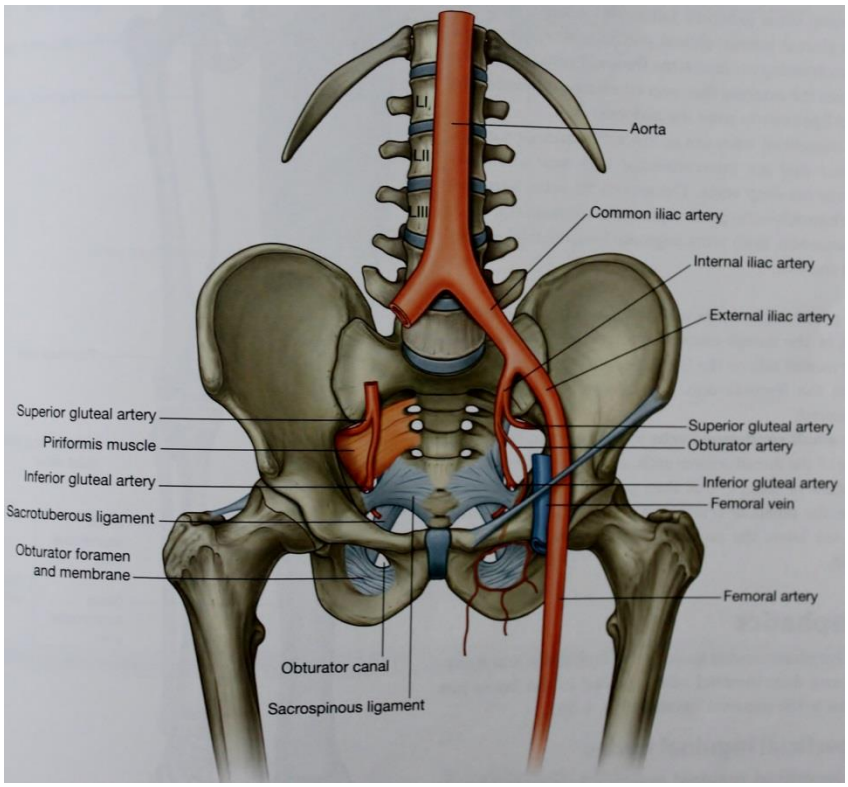


Figure 4 – Arteries supplying the hip and thigh region (Drake et al., 2010, p. 541)

2.1.7 Lymphatics

Most lymphatic vessels in the lower limb drain into superficial and deep inguinal nodes located in the fascia which is inferior to the inguinal ligament. We distinguish between superficial inguinal nodes, deep inguinal nodes and popliteal nodes. (Drake et al., 2010, p. 542)

There are approximately ten **superficial inguinal nodes** located in the superficial fascia and parallel to the inguinal ligament. They receive lymph from the gluteal region, lower abdominal wall, perineum and superficial regions of the lower limb. They drain into external iliac nodes associated with the external iliac artery in the abdomen. (Drake et al, 2010, p. 542)

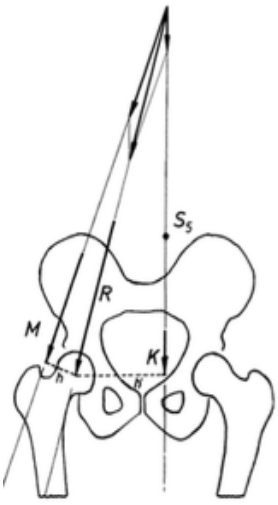
There are up to three **deep inguinal nodes**. They receive lymph from deep lymphatics associated with the femoral vessels and from the glans penis (or clitoris) in the perineum.

They are interconnected with the superficial inguinal nodes and drain into the external iliac nodes. (Drake et al., 2010, pp. 542-543)

The third group of lymphatic nodes in the region is called **popliteal nodes**. They are a small group of deep nodes located posterior to the knee and close to the popliteal vessels. They receive lymph from superficial vessels, which accompany the small saphenous vein, and from deep parts of the leg and foot. They drain into the deep and superficial inguinal nodes. (Drake et al., 2010, p. 543)

2.2 Biomechanics of the hip joint

The hip joint is a major weight-bearing joint. When a person stands on both legs, the hips support the head, the trunk and the upper limbs, which account for 62% of the total body weight. The centre of gravity of this part of the body is located in the vertical plane through the centres of the femoral heads, above the mid-point of the axis joining these two centres. If the weight is distributed evenly, each hip carries 31 % of the body weight. (Maquet, 1985, p. 2) The load on the hip is the result of the patient's weight pulling downwards and muscles pulling the femur medially and upwards at an angle of approximately 1 degree from the vertical. (Dandy, 2003, p. 44)



This changes when a person stands on one leg. In that case, the adductors act at a mechanical disadvantage because they are closer to the centre of the hip joint than the person's centre of gravity. They have to lift about 3 times body weight and the load across the hip is consequently increased. (Dandy, 2003, p. 44)

Figure 5 – Forces acting on the hip in one-leg stance (Maquet, 1985, p. 3)

2.3 Kinesiology of the hip joint

2.3.1 Muscles according to function

The hip joint enables movement in three planes and around three axes, (Kapanji, 183, p. 2) namely in the saggital plane, around the coronal axis; in the coronal plane, around the saggital axis; in the transverse plain, around the longitudinal axis. (Kendall et al., 2005, pp. 54-55)

In the saggital plane, the movements of flexion and extension take place. (Kendall et al., 2005, pp. 54) The muscles which enable the flexion of the hip are the following: the iliopsoas, the tensor fasciae latae, the pectineus, the adductor longus, the adductor brevis, the gracilis, the rectus femoris, and the sartorius. (Platzer, 2009, p. 246)

The muscles which enable the extension of the hip are the following: the gluteus maximus, dorsal fibres of the gluteus medius and gluteus minimus, the adductor magnus, the piriformis, as well as the semimebranosus, thesemitendinosus, and the long head of the biceps femoris. (Platzer, 2009, p. 246)

In the coronal plane, the movements of abduction and adduction take place. (Kendall et al., 2005, p. 54) The muscles which enable the abduction of the hip are the following: the gluteus medius, the tensor fasciae latae, the gluteus maximus, the gluteus minimus, the piriformis, and the obturator internus. (Platzer, 2009, p. 246)

The muscles which enable the adduction of the hip are the following: the adductor magnus and minimus, the adductor longus, the adductor brevis, the gluteus maximus, the gracilis, the pectineus, the obturator externus, the semitendinosus, and the quadratus femoris. (Platzer, 2009, p. 246)

In the transverse plain, the movement of external (lateral) and internal (medial) rotation take place. (Kendall et al., 2005, p. 54) The muscles which enable the external rotation are the following: the gluteus maximus, the quadratus femoris, the obturator internus, the gluteus medius and minimus with their dorsal fibres, the iliopsoas, the piriformis, the sartorius, the obturator externus, the adductor brevis, the adductor longus, the adductor magnus, and the adductor minimus. (Platzer, 2009, p. 240, 244)

The muscles which enable the internal rotation are the following: anterior fibres of the gluteus medius and gluteus minimus, the tensor fasciae latae, the part of the adductor magnus inserted into the adductor tubercle. When the leg is abducted, the pectineus also acts as an internal rotator. (Platzer, 2009, p. 244)

2.3.2 The range of motion

The range of motion of the hip joint differs slightly, depending on the author or institution behind the figures. In the following table there are physiological values for each movement according to Americal Academy of Orthopaedic Surgeons, Kendall and McCreary, and Janda. (Jelínková & Vomáčková, 2014, p. 11)

Movement (degrees)	American Academy of Orthopaedic Surgeons	Kendall and McCreary	Janda
flexion	0-120	0-125	0-120/130
extension	0-30	0-10	0-10/30
abduction	0-45	0-45	0-30/50
adduction	0-30	0-10	0-10/30
internal rotation	0-45	0-45	0-30/45
External rotation	0-45	0-45	0-45/60

Table 1 – Range of motion of the hip joint (Jelínková & Vomáčková, 2014, p. 11)

2.4 Coxartrosis or hip osteoarthritis

Coxartahrosis is a type of osteoarthritis (OA)[1] and it affects the hip joint. (Kolář, 2013, p. 462-463) It is a degenerative disease resulting in progressive breakdown of the joint surface. It can be classified as primary or secondary. (Dandy, 2003, p. 283) It causes pain, loss of movement and altered function. (Dandy, 2003, p. 285). Consequently, it has a negative impact on the patient's daily life. The diagnosis is made on the basis of clinical picture (comprised of both subjective symptoms and objective findings), and imagining imaging methods such as X-rays, (Kolář, 2013, p. 463) although MR arthrography and CT can be used in some cases as well (Bowden, McNally, Thomas, & Gibson, p. 321).

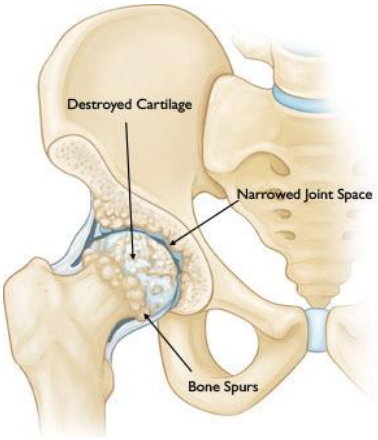


Figure 6 – Hip with coxarthrosis
("Total Hip Replacement", 2015)

2.4.1 Aetiology

The disease most commonly affects people aged 50-60 years or older, but it can also affect younger population. (Hardinge, 1983, p. 3) It is manifested by changes in the mechanical properties of the cartilage. (Kolář, 2013, p. 462)

It can be **primary or idiopathic**. In this type of the disease, the cause in not entirely clear (Solomon, Warwick, & Nayagam, 2010, p. 522). It is believed that disruption in metabolism of the joint cartilage is the basis for the development of this type of OA. (Kolař, 2013, p. 462)

[1]The term osteoarthritis is more commonly used in Anglo-Saxon literature, and it implies that degeneration and inflammation occur simultaneously. The traditional term, osteoarthrosis, suggests that degeneration is a primary and inflammation only a secondary process. (Kolář, 2013, p. 462)

It can be **secondary**. In this type of the disease, the causes are known. They can be anatomical (congenital dysplasia, Leg-Calve-Perthes' disease, length discrepancy, hypermobility syndrome), traumatic (joint trauma, such as dislocation, or microtrauma, caused by excessive loading during sport), matebolic (diabeted mellitus, gout, deficit in steroid metabolism), or inflammatory (rheumatoid arthritis, septic arthritis). (Kolář, 2913, p. 462) The changes which can be observed include the following: joint cartilage can become rough or diminished; subchondral bone can undergo pathological remodelling; osteophytes can appear; pseudocysts can be formed in the bone marrow beneath the subchondral bone. (Kolář, 2013, p. 463)

2.4.2 Clinical picture

The symptoms of coxarthrosis include three principal features: pain, loss of movement, and altered function. (Dandy, 2003, p. 285)

Pain can be felt in the groin or it may radiate to the knee joint. (Solomon et al., 2010, p. 523) In the initial stages it is more pronounced after a person performs certain physical activities, but later it becomes constant, even waking the person up in the middle of the night. (Solomon et al., 2010, p. 523)

The joint becomes stiff (especially after rest) and movement becomes limited as osteophytes form and joint changes its shape. (Dandy, 2003, p. 286) (Solomon et al., 2010, p. 523) The movements which are first to become limited are internal rotation, abduction and extention. (Solomon et al., 2010, p. 523) Flexion becomes difficult too, making activities such as putting shoes on or cutting toe nails difficult. (Bowden et al., 2010, p. 320) The hip muscles become weak, especially the gluteal muscles and muscles of the thigh. (Hardinge, 1983, p. 12)

Alteration of joint function is gradual. The patients may restrict their physical activities without even being aware of it. (Dandy, 2003, p. 286) Eventually, more than 80 % of patients will have limitations in the activities of daily living. (Fautrel et al., 2005)

2.4.3 Making a diagnosis

After taking a careful anamnesis, the physician should evaluate the patient's gait (it often exhibits antalgic or Trendelenburg pattern). ROM should be examined as well as the tone and function of the hip and thigh muscles. Special tests can also be used, such as the Patrick's test and Thomas' test. Trendelenburg sign might be present. Antropometric measurement, especially leg length measurement, can be helpful in making the diagnosis (if discrepancy is present). (Bowden et al., 2010, p. 320)

The American College of Rheumatology has the following diagnostic criteria for hip OA: Erythrocyte sedimentation rate is higher than 20 mm/h; radiographic imaging shows femoral or acetabular osteophytes; and joint space narrowing is present. (Bowden et al., 2010, p. 320)

2.4.4 Surgical treatment

The most popular treatment for hip osteoarthrosis is total hip replacement. It consists of replacing both surfaces of the joint, namely the acetabulum and the femoral head, with artificial materials. Several surgical approaches can be used, as far as the technique is concerned, (Dandy, 2003, pp. 375, 377) and several materials are currently used for the artificial components (Centeno, 2015)

The most common approaches to total hip replacement surgery are the anterior, anterolateral, lateral and posterior approach. The anterior (Smith-Petersen) is not ideal for major reconstructive surgery in adults (Solomon et al., 2010, p. 354), and is more suitable for diagnoses such as DDH or drainage hip sepsis (Bowden et al., 2010, p. 154). Therefore, other approaches are more frequently used for total hip replacement.

Figure 7 – Before and after surgery ("Hip replacement", 2014)

One group of such approaches are the lateral approaches. The main problem is how to deal with the abductor muscles (especially the gluteus medius and minimus), since they obstruct the view of the acetabulum. There are several ways how to deal with this situation: the abductors can be retracted posterosuperiorly; the abductors are split and then the anterior portion is raised from the greater trochanter (Hardinge's direct lateral approach); the greater trochanter is osteotomized and retracted upwards with the attached abductors (Charnley approach). The latter approach especially offers good exposure, but the reattachment of the trochanteric fragment might be somewhat problematic. (Solomon et al., 2010, p. 534)

The posterior approach is the most direct one. The anterior part of gluteus maximus is split, the rotators at the back of the hip are exposed, the sciatic nerve is retracted beneath the posterior portion of gluteus maximus, the short rotators are detached and then the hip is entered directly. This approach has two minor disadvantages: orientation is more difficult and it is associated with a higher incidence of postoperative dislocations. (Solomon et al., 2010, p. 534)

The anterolateral (Watson-Jones) approach is good because there is minimal detachment of muscles. It goes between the gluteus medius and the tensor fasciae latae. Although it also provides a reasonable exposure of the hip, the gluteus medius makes the hip replacement more challenging. (Solomon et al., 2010, p. 534)

Minimally invasive surgery should be mentioned as a possible technique of total hip replacement. It is carried out through a skin incision of less than 10 cm, usually using the anterior or posterior approach. Its main aim is to save soft tissue as much as possible. (Solomon et al., 2010, p. 541)

2.4.4.1 Surgical procedure of total hip replacement

Let us now have a look at the surgical procedure itself. Although there are clear differences depending on the approached used, the principle of total hip replacement is the same. After the incision has been made, the acetabular surface is prepared by the removal of debris and soft tissue. Then the damaged femoral head is removed. The acetabulum is then replaced with an artificial component, which is fixed either mechanically or with bone cement. Lastly, the femoral component is inserted and similarly secured. (Dandy, 2003, p. 377)

2.4.4.2 Materials used for total hip replacement

Metal on Metal (MOM) – Both the socket and the ball are made of stainless steel, titanium, chromium, cobalt or a combination of these. A minimally invasive model of this type also exists, and is usually smaller in size, in order that it can be installed with a smaller incision. The biggest concern regarding this type of material is due to negative health effects caused by wear particles. This problem came to light some 6-8 year ago when surgeons started replacing worn out or failed MOM hips. It was discovered that not only was the area around the hip full of metal debris, but the patient's blood had elevated metal ion levels. Small-framed women who underwent a minimally invasive hip replacement surgery were at the highest risk (it has been shown that the minimally invasive models produce the greatest amount of debris). Patients with metal allergies were also negatively affected. All this lead to changes in the consensus guidelines. As of 2015 the MOM hip replacement is not to be performed on small women or patients with a known metal allergy. (Centeno, 2014)

Polyethylene and Metal on Polyethylene (MOP) - These hip components have metal and plastic parts. One possibility is that a plastic liner (made of polyethylene) is placed between the metal ball and socket. Another possibility is a metal ball meeting a plastic socket liner. One type of a polyethylene hip is made of a cross linked polyethylene, which is a very durable substance. MOP hips wear less, but their wear particles produce similarly bad side-effects as MOM hips. However, the cross linked polyethylene hips are more promising, and

it has been confirmed that they can withstand unexpected wear and part failure better than ordinary MOP hips. (Centeno, 2014)

Ceramic on Metal (COM), Ceramic on Ceramic (COC), Ceramic on Polyethylene (COP) – Ceramic components can be combined with various materials, such as metal, ceramic or plastic. They are durable, but can be broken under big stresses. The COC variety has been proven the best regarding the wear particles and their effect on health. (Centeno, 2014)

Figure 11 – Materials used for hip replacement implants (Fary, 2014)

2.4.4.3 Possible complications of total hip replacement surgery

Like every surgery, a total hip replacement carries some risks. During the operation itself, there may be a fracture of the femur or acetabulum, or the sciatic nerve may get damaged (especially in the posterior approach). The recovery is usually spontaneous. (Solomon et al., 2010, p. 537)

Post-operative dislocation may take place if the setting of the prosthetic components has not been performed correctly. Another surgery may be needed in severe cases. (Solomon et al., p. 537) There can be heterotropic ossification around the hip, which means that soft tissue abnormally turns into bone (Kocic, Lazarovic, Mitkovic, & Djokic, 2010). Osteolysis

can happen, usually when there is a granuloma between the cement and the bone. Bone can also start to decompose due to aseptic loosening of parts of the artificial joint. (Solomon et al., 2010, p. 538) These parts cause chronic inflammation which in turn can cause osteolysis even 10 or 15 years after surgery. (Abu-Amer, Darwech, & Clohisy, 2007) Infection is one of the most serious complications and happens in older patients as well as those who are on immunosuppressive drugs. Deep vein thrombosis is even more serious as it is a life-threatening condition. Post-operative rehabilitation should minimize the possibility of its occurrence. (Solomon et al., 2010, pp. 537, 538)

2.4.5 Rehabilitation of patients with total hip replacement

2.4.5.1 Conservative treatment

Before total hip replacement surgery is considered, the conservative treatment is used. The patient is advised to remain active but avoid activities which aggravate pain or overload the joint. A walking stick or some other aid can be used to facilitate mobility. Analgesics or NSAIDs can be used to manage pain. (Dandy, 2003, p. 286)

Overweight patients have a higher risk of developing hip osteoarthritis, and in such cases the disease tends to be more symptomatic and progresses faster. Therefore, one of the first measures taken is **weight reduction**. Ideally, the patient's BMI should fall within the range 18, 5 – 25. Measures should be taken for the patient to lose excessive and maintain healthy weight. If the disease is already in progress, that will reduce the symptoms of pain and disability. (The Royal Australian College of General Practitioners [RACGP], 2009, p. 23)

Physical exercises of light or moderate intensity can be used to increase muscle strength and the ROM. Exercises which enhance aerobic capacity and endurance, as well as aquatic exercises, are likewise beneficial. (RACGP, 2009, p. 24)

Manual techniques can be used, such as stretching shortened muscles around the hip, and performing traction techniques. (Cibulka, 2006, p. A16)

Physical therapy modalities can be used as well. Infrared lamps or short-wave diathermy can relieve pain for months at a time. (Dandy, 2008, p. 268) TENS can be used to reduce pain while diadynamic currents decrease swelling. (Jeníček, 2014, pp. 22, 28-29) Ice and heat packs can be applied to the affected area. Ice packs can control oedema and numb pain, while heat can reduce stiffness and promote blood flow and joint flexibility. However, heat application can also exacerbate oedema and inflammation, so it should be used with caution. (RACGP, 2009, p. 28)

2.4.5.2 Pre-operative phase

During the pre-operative several things should be addressed: the muscle balance should be corrected and the contractures around the affected joint decreased; measures should be taken for the patient's overall to be improved; he or she should also be taught how to walk with crutches and decreased weight-bearing of the affected leg. If the patient has a faulty breathing pattern, this can be addressed already in the pre-operative phase. Also, the patient should be educated on the early post-operative period, the importance of early verticalization and active participation in a rehabilitation programme. (Kolář, 2013, p. 465)

2.4.5.3 Post-operative phase

Specific therapy is prescribed by the surgeon, and depends on the type of surgical procedure, type of endoprosthesis used and the overall state of the patient (fitness level, age, other diseases, etc.) (Kolář, 2013, p. 465) After the operation the patient usually has some oedema, decresed ROM, impaired muscle strength and decreased balance. (Ellis et al., n. d) Therefore the rehabilitation plan is made in order that these problems are eliminated or minimized.

If the patient didn't learn of contraindicated movements before the operation, he or she should be instructed as soon as possible to avoid hip flexion beyond 90 degrees, external hip rotation and adduction (Jelínková & Vomáčková, 2013, p. 2). Internal hip rotation is likewise contraindicated. (Ellis et al., n. d.) The patient should be reminded of the

importance of the correct positioning, early verticalization and DVT prevention. He or she should be taught how to get from the lying into the sitting position with a protective pillow between his or her knees, (Jelínková & Vomáčková, 2013, p. 2) and perform DVT prevention and breathing exercises. (Kolář, 2013, p. 465)

Cryotherapy can be used shortly following the surgery to control oedema. Other modalities which can be used to reduce oedema are biolamp and laser (Kolář, 2013, p. 465) and theoretically also diadynamic currents (especially the CP type). (Jeníček, 2014, p. 2)

Decreased ROM and muscle strength should be addressed with active and passive movements, and isometric exercises. Hip abduction, extension and flexion should be trained in order to increase the ROM (bearing in mind that 90 degrees is maximal hip flexion allowed). The muscles which particularly need to be strengthened are hip abductors and extensors, but other muscles (such as quadriceps femoris and hip adductors) should be kept in optimal shape too. (Grelsamer, 2004) (C. Karaliotas, personal communication, February 1, 2016)

Regaining the ability to stand and walk is very important after hip surgery. The patient should learn how to walk with crutches or a walker, following his or her doctor's instructions regarding how much weight can be put on the operated extremity. (Grelsamer, 2004)

After the stiches have been taken out of it, the scar should be treated with soft tissue techniques and possibly also laser. (Kolář, 2013, p. 465)

If there are blockages in joints such as sacroiliac, tibiofibular and foot joints, these should be addressed with manual mobilization, such as Lewit's (Lewit, 2010, pp. 195-198, 206-208,) His techniques can also be used for restricted fascias of the lower back and lower extremities (thigh, knee, calf). (Lewit, 2010, pp. 231-235)

If the pain is present for longer periods of time, electrotherapy, such as TENS or interferential currents, can be used to alleviate it. (Jeníček, 2014, p. 28-29; 31-32)

At home, the patients should be cautious about how they perform certain ADLs which in normal circumstances demand contraindicated movements. They should wear shoes with

no shoe laces and put them on using a long shoehorn. That will prevent excessive hip flexion. Sitting in a car, especially in the driver seat, can be problematic, therefore it is recommended that patients refrain from driving until they are able to walk without a cane or other aids. A special cushion should be placed on all kinds of seats, chairs, sofas, etc. to prevent hip flexion beyond 90 degrees. A special seat should be placed on the toilet to reach the same goal. (Ellis et at., n. d.)

Patients are often prescribed balneologic treatment (Kolář, 2013, p. 465), which can speed up the process of healing and rehabilitation. In later stages various aids can be used to increase resistance, such as elastic bands and weights. Balance and proprioceptive exercises should be included in the exercise regime. Walking, aquatic exercises and low-impact aerobics will be likewise beneficial. (Ellis et al., n. d.)

3. Case study

3.1 Methodology

The clinical practice, which served as a basis for the case study, took place at the Institute of Rheumatology (Revmatologický ústav) in Prague, from 1st February to 12th February, 2016. For the physiotherapy staff at the institute, the work day begins at 7.30 a.m. and finishes at 4 p.m. In my case, there were 80 hours of clinical practice in total which I was assigned to carry out. Charis Karaliotas, Bc. served as my supervisor.

I began examining and treating my patient on the third day of my practice, namely 3rd February, 2016. The final examination and the last therapy session took place on 11th February, 2016. In total, I had nine therapy sessions with my patient.

There was one therapy session every day (except Saturday, 6th February). Each session lasted between 45 minutes and one hour. The therapy was mainly carried out in the patient's room, but it also took place in the Institute's corridors and stairways, and the big gym. The patient's treatment predominantly consisted of physical exercises and the application of manual methods. An overball was used for some of the exercises, and a soft ball for lymphatic drainage.

The patient was informed about the nature of examination and therapy procedures, and agreed to them by signing the Informed consent. The FTVS UK Ethics Committee approved my work on 8th February 2016, with the approval no. 059/2016.

3.2 Anamnesis

Name of the patient: M.O.

Year of birth: 1952

Sex: Female

Diagnosis: Total hip replacement (left side) due to coxarthrosis

Code: M160

Present State: The patient is oriented, afebrile, without breathing or gastrointestinal problems, she feels a bit tired, has very slight pain in the operated area (treated with Novalgin).

Weight: 58kg

Height: 170 cm

BMI: 20, 07

BP: 123/80 (on 26. 1. 2016)

BPM: 87/min (on 26. 1. 2016)

Chief complaint: The patient is in the state after total hip replacement on the left side (she was operated on 18th January, 2016), she has limited ROM of the left lower extremity, muscle imbalances and reduced muscle strength. She is not able to walk without crutches, and is not allowed to load the operated lower extremity.

History of the present problem: As a child, the patient wore an orthosis for both hips (till she was 1 year old). She did not undergo any surgical treatment at the time. In the five years prior to the operation, the left hip became progressively more painful (especially six months prior to the surgery).

Past medical history: The patient was diagnosed with bilateral coxarthrosis. According to the MRI carried out in August 2015, she also has a herniated disc (L4/5, left side), severe degeneration of the L2-5 region, and a stenosis of foramen (L2-3, left side). She wore a lumbar belt, which gave minimal results.

Pharmacological anamnesis: Clexane 0, 4 ml s.c. 1x per day, Lipanor 1x 0-0-1, Trittico 75 mg 0-0-0-2/3, Timoptol eye drops, Oxazepam 1x per night, painkillers as needed.

Abuses: The patient does not smoke, but she drinks half a litre of beer and a glass of wine every day.

Allergies: Valetol, Saridon, possibly propylphenazon

Social anamnesis: The patient is married and lives with her husband in a flat on the third floor. There is no lift in the building.

Gynecological anamnesis: The patient has given birth to two children and had one spontaneous abortion. Her menopause began at 52 years of age. The last gynecological examination took place before the operation, in January 2016.

Occupational anamnesis: Retired since June 2015, she used to work as an accountant.

Surgical anamnesis: Total hip replacement of the left hip, on January 18, 2016. Meningeom of the left eye, surgically treated in 2010 (in Ostrava).

Family anamnesis: The patient's grandfather on the mother's side had diabetes mellitus. Her father had three strokes (the last one, at the age of 61, was fatal), and he also had high cholesterol. Her mother had stroke and died at 82. Her sister has unspecified liver disease. The two daughters, as well as all grandchildren, are in good health.

Hobbies and sports: Walking, cycling.

Prior rehabilitation: None in the documentation I have access to.

Excerpt from patient's healthcare file: The patient was operated on at the Bulovka Hospital in Prague, on 18th January, 2016. The implant which was used is a non-cemented LIMA fem 4, M, 32, BIOLOX, 50. She received four blood transfusions, and was transferred to the standard department as soon as her state was stable. She was receiving Clexane 0, 4 ml s.c. daily during her entire stay at the Bulovka Hospital. She also had deep vein thrombosis (DVT) prevention, was verticalized and walked with two French crutches. On the day of the transferal to the Institute of Rheumatology, Prague, (26th January, 2016), the patient was afebrile, with a clean scar (no secretions or signs of infection) and without any signs of DVT.

3.3 Initial kinesiological examination (carried out on 3rd and 4th February, 2016):

- Observation
- Postural examination (with the examination of the pelvis in a sitting and standing position)
- Gait examination
- Examination of breathing
- Muscle tone examination
- Soft tissue examination (according to Lewit)
- Anthropometric measurements
- ROM examination
- Joint play examination (according to Janda)
- Muscle length tests (according to Janda)
- Muscle strength tests (according to Kendall)
- Examination of movement patterns (according to Janda)
- Neurological examination

3.3.1 Observation: I can see some swelling on the anterior and lateral parts of the left thigh. The whole left thigh looks a bit smaller compared to the right thigh. The scar is on the lateral side of the proximal left thigh, but I cannot see it due to the covering. The area of the left knee is visibly swollen, with a haematoma mostly in the popliteal area and on the lateral side of the proximal calf. The whole left calf appears smaller compared to the right thigh. I cannot see the left ankle because it is covered by a bandage (DVT prevention measure), but the patient has a hallux valgus on the right LE.

3.3.2 Breathing examination: The patient was lying in the supine position and was instructed to take three deep breaths. On inspiration, it was the upper thoracic area which was raised first, followed by the lower thoracic and abdominal areas. Therefore, the patient has a faulty breathing pattern (upper thoracic).

3.3.3 Postural examination (in the standing position, with French crutches, without loading the operated extremity):

Anterior view

- a narrow base of support

- the feet are somewhat flat on both sides

- the right foot is externally rotated

- the knees are in the neutral position

- the iliac crest is higher on the left side

- the right thoracobrachial triangle is bigger than the left one

- the right shoulder is slightly elevated

- the head is in the neutral position

- the whole patient is leaning to the right

Lateral view – left

- the knee is slightly flexed

- the pelvis seems to be in a neutral position

- the whole spine is unusually straight, lacking characteristic shape (lordosis in the cervical and lumbar area, and kyphosis in the thoracic and sacral areas); the patient exhibits military posture, according to Kendall

- the shoulders are slightly protracted (due to the patient standing with crutches)

- the head seems to be in a neutral position

Lateral view – right

- the knee is hyperextended

- the pelvis seems to be in a neutral position

- a lack of lordosis in the cervical and lumbar areas as well as kyphosis in thoracic and sacral areas

- the shoulders are slightly protracted (due to the patient standing with crutches)

- the head seems to be in a neutral position

Posterior view

- a narrow base of support

- the right foot is slightly externally rotated

- the popliteal fossas are relatively on the same level

- the left subgluteal line is very slightly higher than the right one

- the iliac crest is higher on the left side

- the right thoracobrachial triangle is bigger than the left one

- the right shoulder is higher than the left one

- the head is relatively straight

- the whole patient is leaning to the right

3.3.4 Examination of the pelvis:

- the iliac crest is higher on the right side

- the PSIS is higher on the left side

- the ASIS is higher on the left side

- a neutral position of the pelvis (in respect to anteversion or retroversion)

3.3.5 Gait examination:

The patient walks with French crutches, without loading the operated limb. Her base of support is rather normal, her walking rhythm non-periodic. She correctly places the crutches first and then moves the operated limb left forward, without loading it. Then she moves the non-operated leg forward and loads it (three-point gait). The patient loads the foot of the non-operated leg in the correct way, only the toe-off phase is absent. The speed of gait is low, but balance seems to be good. The patient has not walked down the stairs yet. During the gait, the trunk of the patient is slightly bent forward. There is no movement of the head.

3.3.6 Muscle tone examination (palpation):

Muscle tested	Right side	Left side
quadriceps (rectus femoris, vastus medialis, vastus intermedius, vastus lateralis)	normal	hypertonic (and painful) vastus lateralis and hypotonic rectus femoris
adductors (add. magnus, add. brevis, add. longus, gracilis, pectineus)	normal	hypertonic
iliopsoas	not examined due to the patient's sensitivity	not examined due to the patient's sensitivity
tensor fasciae latae	normal	normal
erector spinae	normal	normal
quadratus lumborum	normal	normal
gluteal muscles (maximus and medius)	hypotonic	hypotonic
hamstrings (biceps femoris, semitendinosus, semimembranosus)	normal	normal

Table 2 – Muscle tone examination (palpation)

3.3.7 Soft tissue examination

1. Superficial layers of the skin on the lower extremities: I did not find any restrictions on either extremities. The area around the scar (where I expect restrictions) is covered and therefore inaccessible for examination.

2. Fascia of the lower extremities: There is a large haematoma in the area of the left knee, and the patient is very sensitive in that area, which made the examination of the knee fascia difficult. Due to the hematoma, it is safe to assume that the knee fascia is restricted.

3. Scar: The scar is covered, therefore I was not able to examine it. The stitches have not been removed yet.

3.3.8 Anthropometric measurements:

Lower extremity	**Right side (cm)**	**Left side (cm)**
anatomical length (greater trochanter – lateral malleolus)	81	(no measurement because of difficulties in finding the greater trochanter)
functional length (umbilicus – medial malleolus)	92	93
functional length (ASIS – medial malleolus)	86	86

Table 3 – Anthropometric measurements of the lower extremity - length

Lower extremity	**Right side (cm)**	**Left side (cm)**
thigh (15 cm above the knee – rectus femoris)	43	42
thigh (10 cm above the knee – vastus muscle)	39, 5	39, 5
knee	33	35
calf	32, 5	30
ankle	22	22
foot	21	21

Table 4 – Anthropometric measurements of the lower extremity – circumference

3.3.9 ROM examination

Lower extremity

HIP JOINT				
Plane	Right side		Left side	
	Active movement	Passive movement	Active movement	Passive movement
S	10°-0°-110° (flexed knee)	15°-0°-130° (flexed knee)	5°-0°-50° (flexed knee)	10°-0°-60° (flexed knee)
F	30°-0°-25°	45°-0°-30°	30°-0°-*0°	40°-0°-*0°
R	20°-0°-20°	45°-0°-30°	*0°-0°-*0°	*0°-0°-*0°

Table 5 – ROM (hip joint)

*I did not measure hip adduction, internal and external rotations since these movements are contraindicated after total hip replacement.

KNEE JOINT				
Plane	Right side		Left side	
	Active movement	Passive movement	Active movement	Passive movement
S	0°-0°-110°	0°-0°-115°	0°-0°-90°	0°-0°-100°

Table 6 – ROM (knee joint)

ANKLE JOINT				
Plane	Right side		Left side	
	Active movement	Passive movement	Active movement	Passive movement
S	20°-0°-60°	20°-0°-60°	20°-0°-50°	20°-0°-50°
R	15°-0°-35°	15°-0°-35°	10°-0°-30°	10°-0°-30°

Table 7 – ROM (ankle joint)

3.3.10 Joint play examination according to Lewit:

Joint	Right	Left
patellar join (medial, lateral, cranial and caudal direction)	not restricted	not restricted
tibiofibular joint (dorsal and ventral direction)	not restricted	restricted in both directions
talocrural joint (dorsal and ventral direction)	not restricted	restricted in dorsal direction
Lisfranc joint (dorsal and ventral direction)	not restricted	not restricted
Chopart joint (dorsal and ventral direction)	not restricted	not restricted

Table 8 – Joint play examination according to Lewit

3.3.11 Muscle length tests according to Janda:

Muscle examined	Right	Left
gastrocnemius and plantaris	0	0
soleus and politeus	0	0
Hip adductors	0	2

Table 9 – Muscle length tests according to Janda

*The length test for the hip flexors was not performed because the patient felt very insecure in the testing position. The length test for the paravertebral muscles was not performed because my supervisor advised against it. The length test for the hamstrings was not performed due to limited hip flexion.

3.3.12 Muscle strength tests according to Kendall:

Lower extremity

Muscle tested	Right	Left
quadriceps femoris	4	3
gluteus maximus (prone position, flexed knee)	3	2+
gluteus minimus (neutral position)	3	2+
hip adductors (adapted position – supine, isometric contraction only)	3	3
hamstrings (prone position, flexed knee)	4	3+
dorsiflexion muscles	4+	4
plantar flexion muscles	4+	4

Table 10 – Muscle strength tests according to Kendall

3.3.13 Examination of movement patterns according to Janda:

Pattern	Right	Left
hip extension	normal	The hamstrings are activated first, followed by the contralateral erector spinae. The gluteus maximus is activated last.

Table 11 – Examination of movement patterns according to Janda

3.3.14 Neurological examination – sensation:

	Left	Right
L1 dermatome	normal sensation	normal sensation
L2 dermatome	normal sensation	normal sensation
L3 dermatome	normal sensation	normal sensation
L4 dermatome	normal sensation	normal sensation
L5 dermatome	normal sensation	normal sensation
S1 dermatome	normal sensation	normal sensation
S2 dermatome	normal sensation	normal sensation

Table 12 – Neurological examination - sensation

3.3.15 Neurological examination – deep tendon reflexes (according to the conventional scale presented during the lectures of Professor David Pánek, PhD. (Pánek, 2014, p. 57))

	Right	Left
Patellar reflex	2	2
Achilles tendon reflex	1	1

Table 13 – Neurological examination – deep tendon reflexes

3.3.16 Transfers and ADLs:

The patient is able to go from the supine into side-lying as well as prone position without major problems. She is able to get into the sitting position and to stand up (with the crutches, without loading the operated limb). She is able to perform all ADLs that don't require the loading of the operated leg, gait without crutches, and the movements which are contraindicated after a total hip replacement surgery.

3.3.17 Summary of examination:

The initial examination has shown several aspects of the patient's physical condition which are not physiological.

1. There is some swelling on the anterior and lateral part of the left thigh as well as around the left knee (mostly in the popliteal fossa and on the lateral side of the proximal calf). There is a scar with stiches on the lateral side of the proximal left thigh, but its size and condition are still not visible due to the sterile dressing.

2. The observation of the patient's posture has revealed flat feet on both sides and hallux valgus on the left foot. The patient's right foot is externally rotated and the right knee is hyperextended. The iliac crest is higher on the left side and the right thoracobrachial triangle is bigger than the left one. The patient's right shoulder is slightly elevated and the whole patient is leaning to the right. She has military posture according to Kendall and lacks the characteristic spinal curves.

Examination of the pelvis revealed that the iliac crest, the PSIS and ASIS are all higher on the left side.

3. The patient's gait is non-periodic with normal base of support. The loading of the foot (on the non-operated side) is correct, but the toe-off phase is absent. The speed of gait is low, the balance is satisfactory (on a flat surface). While walking, the patient leans slightly forward and does not move her head very much. She walks with French crutches (three-point gait).

4. The patient exhibits a faulty breathing pattern, namely the upper thoracic pattern.

5. The examination of muscle tone (palpation) has revealed hypertone and pain in the left vastus lateralis muscle; hypotone of the left rectus femoris; hypertone of the left adductors; and hypotone of the gluteus maximus on both sides. The iliopsoas muscle has not been examined due to the patient's sensitivity.

6. Antropometric measurements have shown that the left thigh (15 cm above the knee) has a circumference of 42 cm, which is 1 cm less than the right thigh. The left knee is 35 cm in

circumference, which is 2 cm more than the right knee. Lastly, the left calf is 30 cm in circumference, which is 2, 5 cm less than the right calf.

7. The examination of the ROM revealed the following:

In the hip joint the ROM is generally more limited on the operated side. Hip extention on the left side is 5 degrees active and 10 degrees passive, which is 5 degrees less than normal according to Janda. Flexion is also limited – with 50 degrees active and 60 degrees passive. This is 70 degrees less than the lower limit according to Janda. Abduction is not limited if we take into account the values described by Janda – 30 degrees active and 40 degrees passive is the lower limit of what he deemed physiological. However, since the upper limit is 50 degrees, there is still some room for improvement. Interestingly enough, rotations are limited in both directions (internal and external) in the case of the right (non-operated) hip. External rotation is 20 degrees active and 45 degrees passive, which is 25 degrees less than normal according to Janda, and internal rotation is 20 degrees active and 30 degrees passive, which is 10 degrees less than normal according to Janda.

In the knee joint the ROM is limited on both sides. Flexion is 110 degrees active and 115 degrees passive on the right side, which is 15 degrees less than normal according to Janda. There is even more limitation on the left side – flexion is 90 degrees active and 100 degrees passive, which is 35 degrees less than normal according to Janda.

As far as the ankle is concerned, there is some hypermobility in plantar flexion on the right side, both active and passive plantar flexion being around 60 degrees. That is 10 degrees more than normal according to Janda. On the left side, inversion is 30 degrees, which means it is limited for 5 degrees according to Janda.

8. The examination of joint play has revealed that the tibiofibular and talocrural joints on the left LE are blocked.

9. The muscle length examination has revealed grade 2 shortness (according to Janda) of the left adductors. The length of the hip flexors has not been examined, because the patient did not feel comfortable and stable in the testing position.

10. The examination of muscle strength according to Kendall has revealed the following: no muscle tested has a grade 5 strength. Grade 4 + has been assigned to the following muscles: the muscles responsible for dorsiflexion and plantar fexion of the left foot. These muscles have been assigned grade 4: the quadriceps femoris on the right LE, the hip adductors on the right LE, the hamstrings on the right LE and the muscles responsible for dorsiflexion and plantar flexion of the left foot. Grade 3+ has been assigned to these muscles: the hip adductors on the left LE and the hamstrings on the left LE. The quadriceps femoris on the left LE has been assigned grade 3. The gluteus maximus and gluteus medius on the LE have been assigned grade 2+.

11. The patient exhibits a faulty movement pattern of hip extension.

12. The patient's Achilles reflex is less pronounced on both sides.

3.3.18 Conclusion of examination:

There is swelling on the anterior and lateral part of the left thigh and around the left knee. The patient has a scar. There are some postural and pelvic abnormalities, including flat feet, hallux valgus, the external rotation of the right foot and the hyperextension of the right knee; the iliac crest, the PSIS and the ASIS are all higher on the left side (most likely due to the prosthetic implant). No loading of the operated leg is allowed. The patient's gait is non-periodic and three-point; she uses French crutches. The patient has a faulty breathing pattern (upper thoracic).

There is hypertone in the left vastus lateralis and left adductors. Hypotone is present in the left rectus femoris and the gluteus maximus on both sides. Antropometric measurements show that the left thigh (15 cm above the knee) is 1 cm smaller in circumference than the right thigh. The left knee is 2 cm bigger in circumference than the right knee. Lastly, the left calf is 2, 5 cm smaller than the right calf.

In the hip joint the ROM is generally more limited on the operated side. Hip extension on the left side is 5 degrees less than normal according to Janda. Flexion is also limited - 70 degrees less than the lower limit according to Janda. Rotations are limited in both directions

(internal and external) in the case of the right (non-operated) hip. External rotation is 25 degrees less than normal according to Janda, and internal rotation is 10 degrees less than normal according to Janda. In the knee joint the ROM is limited on both sides. Flexion on the right side is 15 degrees less than normal according to Janda. On the left side the limitation is even bigger - 35 degrees less than normal according to Janda. There is some hypermobility in the right ankle joint – 10 degrees more than what is normal for plantar flexion according to Janda. The left side is limited – there are 5 degrees less of inversion according to Janda.

The tibiofibular and talocrural joints on the left LE are blocked.

3.4 Rehabilitation plan:

3.4.1 Short-term rehabilitation plan:

-prevention of the deep vein thrombosis

- correction of the breathing pattern

- mobilization of the tibiofibular and talocrural joints

- relaxation of hypertonic muscles on the left side (the quadriceps femoris and hip adductors)

- increase of the ROM in the case of joints which are restricted on the left LE (the hip joint in the direction of flexion and abduction; the knee joint in the direction of flexion)

- stretching of shortened muscles on the left LE (the hip adductors)

- strengthening of weak muscles on the left LE (the rectus femoris) and on both extremities (the hip abductors, hip adductors and gluteus maximus)

- improvement of gait

- elimination of swelling

- mobilization of the scar

3.4.2 Long-term rehabilitation plan:

- correction of postural abnormalities

- increase in the muscle strength in all muscles which will still be weak after the patient leaves the hospital

- increase in the ROM of all the joints of the LE that will still have a limited ROM

-correction of either hypo- or hypertone that may still be present after the patient leaves the hospital

- correction of muscle shortness that may still be present after the patient leaves the hospital

- improvement in balance whilst standing and walking

- spa treatment (beginning 21.4.2016)

- the mastery of all ADLs

- correction of the faulty hip movement pattern

3.5 Therapy progress:

Date: Wednesday, 3. 2. 2016

Objective status praesens: Today is the 16th day after surgery.

Subjective status praesens: The patient feels generally good, but she is a bit tired. Changing position (e.g. from the supine to side-lying) is especially tiring for her. The level of pain in the left hip area (VAS) is 2/10 when lying and 3/10 when exercising.

Goals of therapy:

1. To prevent thromboembolism

2. To teach the correct breathing pattern

3. To mobilize the tibiofibular and talocrural joints

5. To relax and stretch the quadriceps muscle on the left side and the hip adductors on the left side

6. To increase the ROM of the left hip (abduction, flexion) and knee (flexion)

7. To strengthen the left rectus femoris, gluteus maximus, hip abductors and adductors

8. To improve the patient's gait

9. To decrease swelling of the left knee

Implementation of therapy

During the therapy session:

1. The patient was in the supine position. She performed flexion and extension of the toes (10 times), dorsiflexion and palmar flexion of the ankles - simultaneously (5 times) and interchangeably (5 times).

2. The patient was in the supine position. I explained what the correct breathing pattern looked like and how it was different from her breathing pattern. Then I placed my hand on the patient's lower abdomen and instructed her to breathe under my hand, as if she wanted to push it away from her body with her abdomen, and then breathe out. We repeated the procedure 15 times.

3. I performed mobilization of the tibiofibular and talocrural joints according to Lewit.

4. To relax and stretch the quadriceps muscle, the patient was in the sitting position. I performed PIR with light stretching (3 repetitions). To relax and stretch the adductors, the patient was in the supine position. I performed PIR with light stretching (3 repetitions).

5. To increase the ROM of the left hip, passive movements with light stretching were performed (up to the point of pain); to increase the ROM of the left knee, active as well as passive movements with light stretching were used.

Supine position: Hip abduction on the left side – 10 passive movements (ending with a light stretch) in the direction of abduction. Hip flexion on the left side – 10 passive movements (ending with a light stretch) in the direction of flexion. Knee flexion on the left side – the patient actively flexed her left knee by rolling an overball with her heel in the direction of flexion (10 active movements).

Prone position: Knee flexion on the left side - 10 passive movements (ending with a light stretch), 10 active movements.

6. To strengthen the rectus femoris on the left side, the patient was lying in the supine position. She had an overball under her knee and she was instructed to push it down into the bed (10 repetitions). Her foot was in maximal dorsiflexion during this exercise.

To strengthen the hip abductors, the patient was lying in the supine position with flexed knees. I provided pressure in the direction of adduction and the patient was instructed to provide counter-pressure in the direction of hip abduction (20 repetitions). To prevent excessive hip adduction, an overball was placed between the patient's knees.

To strengthen the hip adductors, the patient was lying in the supine position with her knees flexed and an overball placed between them. She was instructed to press the ball (20 repetitions).

To strengthen the gluteus maximus, the patient was lying in the supine position with her knees flexed. She was instructed to lift her pelvis, contract her gluteal muscles and after a couple of seconds relax them and put the pelvis on the bed (20 repetitions). The patient was then instructed to turn around (prone position). I placed my hand on her left thigh and provided pressure. The patient did an isometric contraction of the gluteus maximus on the left side (10 repetitions). An exercise with an overball was also used: the ball was placed under her heel and she was instructed to push the ball down into the bed with her heel (10 repetitions).

7. The patient felt tired after the exercises and asked if she could train gait tomorrow.

8. To decrease the swelling in the area of the left knee, I performed lymphatic drainage massage using a softball. I tried to push the lymph up by lightly pressing the softball in the cranial direction.

Results of therapy: The patient understood all of the exercises and was able to do them. She was cooperative. The mobilization of the tibiofibular joint according to Lewit was very uncomfortable due to the haematoma. I was not able to use enough force and am thinking of discontinuing the mobilization if the area continues to be sensitive. After today's session there were still no measurable results.

Self-therapy: The patient was instructed to perform thromboembolic prevention exercises as many times as she wanted. She was instructed to keep her legs in a neutral position when lying, thus avoiding excessive external rotation. When she wants to go to a side-lying position, or when she wants to get into the sitting position, she is to put a protective pillow between her knees.

Date: Thursday, 4. 2. 2016

Objective status praesens: Today is the 17th day after surgery. The stitches were taken out yesterday, but due to bleeding the patient's scar is still covered with a sterile dressing.

Subjective status praesens: Generally speaking the patient feels good, but there is some pain in the area of the left adductors, which could be a consequence of stretching. The level of pain in the left hip area (VAS) is 2/10 when lying and 3/10 when exercising.

Goals of therapy:

1. To prevent thromboembolism

2. To teach the correct breathing pattern

3. To mobilize the left tibiofibular and talocrural joints

4. To relax the quadriceps muscle on the left side and the hip adductors on the left side

5. To increase the ROM of the left hip (abduction, flexion) and knee (flexion)

6. To strengthen the left rectus femoris, gluteus maximus, hip abductors and adductors.

7. To improve the patient's gait

8. To decrease swelling of the left knee

Implementation of therapy

During the therapy session:

1. The patient was in the supine position. She performed flexion and extension of the toes (10 repetitions), dorsiflexion and palmar flexion of the ankles, simultaneously (5 times) and interchangeably (5 times).

2. The patient was in the supine position. I reminded her of what the correct breathing pattern looked like and how it was different from her breathing pattern. I placed my hand on her lower abdomen and instructed her to breathe under my hand, as if she wanted to push it away from her body with her abdomen, and then breathe out. The patient repeated the procedure 15 times.

3. I performed mobilization of the left tibiofibular and talocrural joints according to Lewit.

4. To relax and stretch the quadriceps muscle, the patient was in the sitting position. I performed PIR with stretching (3 repetitions).

5. To increase the ROM of the left hip, passive movements with light stretching were performed (up to the point of pain); to increase the ROM of the left knee, active as well as passive movements with light stretching were used.

Supine position: Hip abduction on the left side – 10 passive movements (ending with a light stretch) in the direction of abduction. Knee flexion on the left side – the patient actively flexed her left knee by rolling an overball with her heel in the direction of the knee flexion (10 active movements).

Prone position: Knee flexion on the left side - 10 passive movements (ending with a light stretch), 10 active movements.

6. To strengthen rectus femoris on the left side, the patient was lying in the supine position. She had an overball under her knee and she was instructed to push it down into the bed (10 repetitions). Her foot was in maximal dorsiflexion during this exercise.

To strengthen the hip abductors, the patient was lying in the supine position with flexed knees. I provided pressure in the direction of adduction and the patient was instructed to provide counter-pressure in the direction of hip abduction (20 repetitions). To prevent excessive hip adduction, an overball was placed between the patient's knees.

To strengthen the hip adductors, the patient was lying in the supine position with her knees flexed and an overball placed between them. She was instructed to press the ball (20 repetitions).

To strengthen the gluteus maximus, the patient was lying in the supine position with her knees flexed. She was instructed to lift her pelvis, contract her gluteal muscles, and after a couple of seconds relax them and put the pelvis on the bed (20 repetitions). The patient was then instructed to turn around (prone position). I placed my hand on her thigh and provided pressure. The patient did an isometric contraction of the gluteus maximus on the left side (10 repetitions). An exercise with an overball was also used: the ball was placed under her heel and she was instructed to push the ball down into the bed with her heel (10 repetitions).

7. The patient felt tired after the exercises and asked if she could train gait tomorrow.

8. To decrease the swelling in the area of the left knee, I performed lymphatic drainage massage using a softball. I tried to push the lymph up by lightly pressing the softball in the cranial direction.

Results of therapy: The patient was able to do all the exercises and was cooperative. Due to pain during the mobilization of the tibiofibular joint according to Lewit, I decided I would discontinue that procedure as long as the area continues to be painful.

Notes: I forgot to perform the ROM regime for the hip (flexors, adductors).

Self-therapy: The patient was instructed to perform thromboembolic prevention exercises as many times as she wanted. She was reminded to keep her legs in a neutral position when lying, and to use a protective pillow when getting into the side-lying or sitting position.

Date: Friday, 5. 2. 2016

Objective status praesens: Today is the 18th day after surgery.

Subjective status praesens: The patient did not sleep well but is not tired. I was able to see the scar when the nurse was changing the dressing and cleaning it, and I can say the scar looks rather good except for some minor areas which are still forming a scab. The level of pain in the left hip area (VAS) is 2/10 when lying and 3/10 when exercising.

Goals of therapy:

1. To prevent thromboembolism

2. To teach the correct breathing pattern

3. To mobilize the left talocrural joint

4. To relax the quadriceps muscle on the left side and the hip adductors on the left side

5. To increase the ROM of the left hip (abduction, flexion) and knee (flexion)

6. To strengthen left rectus femoris, gluteus maximus, hip abductors and adductors

7. To improve the patient's gait

8. To decrease swelling of the left knee

Implementation of therapy

During the therapy session:

1. The patient was in the supine position. She performed flexion and extension of the toes (10 repetitions), dorsiflexion and palmar flexion of the ankles, simultaneously (10 times) and interchangeably (10 times).

2. I placed my hand on the patient's lower abdomen and instructed her to breathe under my hand, as if she wanted to push it away from her body with her abdomen, and then breathe out. We repeated the procedure 15 times.

3. I performed mobilization of the left talocrural joint according to Lewit.

4. To relax and stretch the quadriceps muscle, the patient was in the sitting position. I performed PIR with light stretching (3 repetitions). To relax and stretch the adductors, the patient was in the supine position. I performed PIR with light stretching (3 repetitions).

5. To increase the ROM of the left hip, passive movements with light stretching were used (up to the pain point); to increase the ROM of the left knee, passive movements with light stretching and active exercises were used.

Supine position: Hip abduction on the left side – 10 passive movements (ending with a light stretch) in the direction of abduction. Hip flexion on the left side – 10 passive movements (ending with a light stretch) in the direction of flexion. Knee flexion on the left side – the patient actively flexed her left knee by rolling an overball with her heel in the direction of flexion (10 active movements).

Prone position: Knee flexion on the left side - 10 passive movements (ending with a light stretch); 10 active movements.

6. To strengthen the rectus femoris on the left side the patient was lying in the supine position. She had an overball under her knee and she was instructed to push it down into the bed (10 repetitions).

To strengthen the hip abductors, the patient was lying in the supine position with flexed knees. I provided pressure in the direction of hip adduction and the patient was instructed to provide counter-pressure in the direction of hip abduction (20 repetitions). To prevent excessive hip adduction, an overball was placed between the patient's knees.

To strengthen the hip adductors, the patient was lying in the supine position with her knees flexed and an overball placed between them. She was instructed to press the ball (20 repetitions).

To strengthen the gluteus maximus the patient was lying in the supine position with her knees flexed. She was instructed to lift her pelvis, contract her gluteal muscles and after a couple of seconds relax them and put the pelvis on the bed (20 repetitions). The patient was then instructed to turn around (prone position). I placed my hand on her thigh and provided pressure. The patient did an isometric contraction of the gluteus maximus on the left side (10 repetitions). An exercise with an overball was also used: the ball was placed under her heel and she was instructed to push the ball down into the bed with her heel (10 repetitions).

7. The patient tried walking with French crutches. She was instructed about the correct use of crutches and the correct gait sequence (crutches, operated leg, non-operated leg).

8. To decrease the swelling in the area of the left knee, I performed lymphatic drainage massage using a softball. I tried to push the lymph up by lightly pressing the softball in the cranial direction.

Results of therapy: The patient understood all exercises and was able to do them. She was cooperative and less fatigued than the previous days. The breathing patter is slowly improving. I could feel the adequate activation of the lower abdominal muscles and more counter-pressure to my hand. The mobilization of the talocrural joint has been successful and the joint exhibits good joint play. Mobilization will therefore be discontinued. The ROM of the left knee is improving – today we reached 100 degrees of active flexion and 110 degrees of passive flexion. The patient walked in the corridor and did well.

Self-therapy: The patient was instructed to perform thromboembolic prevention exercises as many times as she wanted. She has to keep her legs in a neutral position when lying, and use a protective pillow when getting into the side-lying or sitting position in order to avoid hip adduction and rotations. The patient was also instructed to pay attention to the gait sequence when she goes out of her room by herself.

Date: Sunday, 7. 2. 2016

Objective status praesens: Today is the 19th day after surgery.

Subjective status praesens: The patient did not sleep well again. The level of pain in the left hip area (VAS) is 2/10.

Goals of therapy:

1. To prevent thromboembolism

2. To teach the correct breathing pattern

3. To relax the quadriceps muscle on the left side and the hip adductors on the left side

4. To increase the ROM of the left hip (abduction, flexion) and knee (flexion)

5. To strengthen the left rectus femoris, gluteus maximus, hip abductors and adductors.

6. To improve the patient's gait

7. To decrease swelling of the left knee

Implementation of the therapy

During the therapy session:

1. The patient was in the supine position. She performed flexion and extension of the toes (10 times), dorsiflexion and palmar flexion of the ankles, simultaneously (10 times) and interchangeably (10 times).

2. I placed my hand on the patient's lower abdomen and instructed the patient to breathe under my hand, as if she wanted to push it away from her body with her abdomen, and then breathe out. We repeated the procedure 15 times.

3. To relax and stretch the quadriceps muscle, the patient was in the sitting position. I performed PIR with light stretching (3 repetitions). To relax and stretch the adductors, the patient was in the supine position. I performed PIR with light stretching (3 repetitions).

4. To increase the ROM of the left hip, passive movements with light stretching were used (up to the pain point); to increase the ROM of the left knee, passive movements with light stretching and active exercises were used.

Supine position: Hip abduction on the left side – 10 passive movements (ending with a light stretch) in the direction of abduction. Hip flexion on the left side – 10 passive movements (ending with a light stretch) in the direction of flexion. Knee flexion on the left side – the patient actively flexed her left knee by rolling an overball with her heel in the direction of knee flexion (10 active movements).

Prone position: Knee flexion on the left side - 10 passive movements (ending with a light stretch); 10 active movements.

5. To strengthen the rectus femoris on the left side, the patient was lying in the supine position. She had an overball under her knee and she was instructed to push it down into the bed (10 repetitions).

To strengthen the hip abductors, the patient was lying in the supine position with flexed knees. I provided pressure in the direction of hip adduction and the patient was instructed to provide counter-pressure in the direction of hip abduction (20 repetitions). To prevent excessive hip adduction, an overball was placed between the patient's knees.

To strengthen the hip adductors, the patient was lying in the supine position with her knees flexed, and an overball was placed between them. She was instructed to press the ball (20 repetitions).

To strengthen gluteus maximus, the patient was lying in the supine position with her knees flexed. She was instructed to lift her pelvis, contract her gluteal muscles and after a couple of seconds relax them and put the pelvis on the bed (20 repetitions). The patient was then instructed to turn around (prone position). I placed my hand on her thigh and provided pressure. The patient did an isometric contraction of the gluteus maximus on the left side (10 repetitions).

6. Today the patient walked down the corridor and also tried walking on the stairs for the first time after her operation. She was rather unstable on the stairs, especially on the way down (5 stairs). The patient walked with French crutches.

7. To decrease the swelling in the area of the left knee, I performed lymphatic drainage massage using a softball. I tried to push the lymph up by lightly pressing the softball in the cranial direction.

Results of therapy: The patient was cooperative. Today the patient reached 70 degrees of active hip flexion on the left side and 110 of knee flexion (both active and passive, on the left side). The breathing pattern keeps improving. The patient had some pain when doing exercises for the left quadriceps. The patient used the correct gait sequence and had good

balance on a flat surface. She also walked on the stairs. There the balance was not very good – she had difficulties especially when descending the stairs. There is less swelling around the treated knee.

S**elf-therapy:** The patient was instructed to perform thromboembolic prevention exercises as many times as she wanted. She has to keep her legs in a neutral position when lying, and use a protective pillow when getting into the side-lying or sitting position, in order to avoid hip adduction and rotations. She has to pay attention to the gait sequence when she goes out of her room by herself.

Date: Monday, 8. 2. 2016

Objective status praesens: Today is the 20th day after surgery. The scar has been uncovered. It is not very big, some 12 cm in length, with several small scabs and no secretion.

Subjective status praesens: The patient feels relatively good. The level of pain in the left hip area (VAS) is 2/10.

Goals of therapy:

1. To prevent thromboembolism

2. To teach the correct breathing pattern

3. To relax the quadriceps muscle on the left side and the hip adductors on the left side

4. To increase the ROM of the left hip (abduction, flexion) and knee (flexion)

5. To strengthen the left rectus femoris, gluteus maximus, hip abductors and adductors.

6. To improve the patient's gait

7. To decrease swelling of the left knee

8. To mobilize the scar

Implementation of therapy

During the therapy session:

1. The patient was in the supine position. She performed flexion and extension of the toes (10 times), dorsiflexion and palmar flexion of the ankles, simultaneously (10 times) and interchangeably (10 times).

2. I placed my hand on the patient's lower abdomen and instructed the patient to breathe under my hand, as if she wanted to push it away from her body with her abdomen, and then breathe out. We repeated the procedure 15 times.

3. To relax and stretch the quadriceps muscle, the patient was in the sitting position. I performed PIR with light stretching (3 repetitions). To relax and stretch the adductors, the patient was in the supine position. I performed PIR with light stretching (3 repetitions).

4. To increase the ROM of the left hip, passive movements with light stretching were used; to increase the ROM of the left knee, passive movements with light stretching and active exercises were used.

Supine position: Hip abduction on the left side – 10 passive movements (ending with a light stretch) in the direction of abduction. Hip flexion on the left side – 10 passive movements (ending with a light stretch) in the direction of flexion. Knee flexion on the left side – the patient actively flexed her left knee by rolling an overball with her heel in the direction of flexion (10 active movements).

Prone position: Knee flexion on the left side - 10 passive movements (ending with a light stretch); 10 active movements.

5. To strengthen the rectus femoris on the left side, the patient was lying in the supine position. She had an overball under her knee and was instructed to push it down into the bed (10 repetitions).

To strengthen the hip abductors, the patient was lying in the supine position with flexed knees. I provided pressure in the direction of hip adduction and the patient was instructed to provide counter-pressure in the direction of hip abduction (20 repetitions). To prevent excessive hip adduction, an overball was placed between the patient's knees.

To strengthen the hip adductors, the patient was lying in the supine position with her knees flexed and an overball was placed between them. She was instructed to press the ball (20 repetitions).

To strengthen gluteus maximus, the patient was lying in the supine position with her knees flexed. She was instructed to lift her pelvis, contract her gluteal muscles and after a couple of seconds relax them and put the pelvis on the bed (15 repetitions). The patient was then instructed to turn around (prone position). I placed my hand on her thigh and provided pressure. The patient did an isometric contraction of the gluteus maximus on the left side (10 repetitions). An exercise with an overball was also used: the ball was placed under her heel and she was instructed to push the ball down into the bed with her heel (10 repetitions).

6. Today the patient walked down the corridor and back to her room and also walked on the stairs with French crutches.

7. To decrease the swelling in the area of the left knee, I performed lymphatic drainage massage using a softball. I tried to push the lymph up by lightly pressing the softball in the cranial direction.

8. To mobilize the scar, I performed c and s-shapes, and horizontal stretching. I did not press the scar directly as there are still some scabs left.

Results of therapy: The patient was cooperative. The breathing pattern looked much better. The left quadriceps and adductor muscles have not been relaxed successfully and still have greater tone than the corresponding muscles on the right side. The gait is steadily improving - the patient had more balance today and was able to walk much faster on a flat surface. Going up the stairs has improved, but going down the stairs still poses challenges for balance. The swelling around the knee is disappearing.

Self-therapy: The patient was instructed to perform thromboembolic prevention exercises as many times as she wanted. She has to keep her legs in a neutral position when lying, and use a protective pillow when getting into the side-lying or sitting position in order to avoid hip adduction and rotations. She has to pay attention to the gait sequence when she goes out of her room by herself. She is not allowed to walk up and down the stairs alone.

Date: Tuesday, 9. 12. 2016

Objective status praesens: Today is the 21st day after surgery.

Subjective status praesens: The patient slept well and is not tired. The level of pain in the left hip region (VAS) is 1-2/10. The patient has pain in the lower back area.

Goal of therapy:

1. To prevent thromboembolism

2. To teach the correct breathing pattern

3. To relax the quadriceps muscle on the left side and the hip adductors on the left side

4. To increase the ROM of the left hip (abduction, flexion) and knee (flexion)

5. To strengthen the left rectus femoris, gluteus maximus, hip abductors and adductors.

6. To improve the patient's gait

7. To decrease swelling of the left knee

8. To mobilize the scar

Implementation of therapy:

1. The patient was in the supine position. She performed flexion and extension of the toes (10 times), dorsiflexion and palmar flexion of the ankles, simultaneously (10 times) and interchangeably (10 times).

2. I placed my hand on the patient's lower abdomen and instructed the patient to breathe under my hand, as if she wanted to push it away from her body with her abdomen, and then breathe out. We repeated the procedure 15 times.

3. To relax and stretch the quadriceps muscle, the patient was in the sitting position. I performed PIR with light stretching (3 repetitions). To relax and stretch the adductors, the patient was in the supine position. I performed PIR with light stretching (3 repetitions).

4. To increase the ROM of the left hip, passive movements with light stretching were used (up to the pain point); to increase the ROM of the left knee, passive movements with light stretching and active exercises were used.

Supine position: Hip abduction on the left side – 10 passive movements (ending with a light stretch) in the direction of abduction. Hip flexion on the left side – 10 passive movements (ending with a light stretch) in the direction of flexion. Knee flexion on the left side – the patient actively flexed her left knee by rolling an overball with her heel in the direction of flexion (10 active movements).

Prone position: Knee flexion on the left side - 10 passive movements (ending with a light stretch); 10 active movements.

5. To strengthen rectus femoris on the left side, the patient was lying in the supine position. She had an overball under her knee and she was instructed to push it down into the bed (10 repetitions).

To strengthen the hip abductors, the patient was lying in the supine position with flexed knees. I provided pressure in the direction of hip adduction and the patient was instructed to provide counter-pressure in the direction of hip abduction (20 repetitions). To prevent excessive hip adduction an overball was placed between the patient's knees.

To strengthen the hip adductors, the patient was lying in the supine position with her knees flexed and an overball placed between them. She was instructed to press the ball (20 repetitions).

To strengthen the gluteus maximus the patient was lying in the supine position with her knees flexed. She was instructed to lift her pelvis, contract her gluteal muscles and after a couple of seconds relax them and put the pelvis on the bed (15 repetitions). The patient was then instructed to turn around (prone position). I placed my hand on her thigh and provided pressure. The patient did an isometric contraction of the gluteus maximus on the left side (15 repetitions). The patient also performed 5 active movements of hip extension (with a flexed knee and fixated pelvis).

6. The patient walked in the corridor and up and down the stairs.

7. To decrease the swelling in the area of the left knee, I performed lymphatic drainage massage using a softball. I tried to push the lymph up by lightly pressing the softball in the cranial direction.

8. To mobilize the scar, I performed c and s-shapes, stretched the scar horizontally and pressed the scar with my thumb.

Results of therapy: The patient was cooperative and performed all exercises well. Hip flexion reached 80 degrees today (active, left side). Hip extension was 10 degrees (active, left side). Knee flexion was 100 degrees (active, left side) and slightly more when performed passively (but with pain!). The scar looked very nice and is becoming more and more mobile. Today was the first day that there was no swelling in the left knee area. Gait is good, except downstairs. (The patient tends to rush and forgets about the correct gait sequence. Therefore, she was instructed to say the sequence out loud when walking down the stairs.)

Self-therapy: The patient was instructed to perform thromboembolic prevention exercises as many times as she wanted. As usual, she has to keep her legs in a neutral position when lying, and use a protective pillow when getting into the side-lying or sitting position. She

has to mind the gait sequence when walking herself (she is advised to have her husband watch over her if she decides to walk down the stairs without me).

Date: Wednesday, 10. 2. 2016

Objective status praesens: Today is the 22nd day after surgery.

Subjective status praesens: The patient did not sleep well. The level of pain in the left hip area (VAS) is 2/10. The patient has pain in the left thigh and the feeling of heaviness.

Goals of therapy:

1. To prevent thromboembolism

2. To teach the correct breathing pattern

3. To relax the quadriceps muscle on the left side and the hip adductors on the left side

4. To increase the ROM of the left hip (abduction, flexion) and knee (flexion)

5. To strengthen the left rectus femoris, gluteus maximus, hip abductors and adductors.

6. To improve the patient's gait

7. To mobilize the scar

Implementation of therapy

During the therapy session:

1. The patient was in the supine position. She performed flexion and extension of the toes (10 times), dorsiflexion and palmar flexion of the ankles, simultaneously (10 times) and interchangeably (10 times).

2. I placed my hand on the patient's lower abdomen and instructed the patient to breathe under my hand, as if she wanted to push it away from her body with her abdomen, and then breathe out. We repeated the procedure 15 times.

3. To relax and stretch the quadriceps muscle, the patient was in the sitting position. I performed PIR with light stretching (3 repetitions). To relax and stretch the adductors, the patient was in the supine position. I performed PIR with light stretching (3 repetitions).

4. To increase the ROM of the left hip, passive movements with light stretching were used (up to the pain point); to increase the ROM of the left knee, passive movements with slight stretching and active exercises were used.

Supine position: Hip abduction on the left side – 15 passive movements (ending with a light stretch) in the direction of abduction. Hip flexion on the left side – 5 passive movements (ending with a light stretch) and 10 active movements in the direction of flexion.

Prone position: Knee flexion on the left side - 10 passive movements (ending with a light stretch); 10 active movements.

5. To strengthen the rectus femoris on the left side the patient was lying in the supine position. She had an overball under her knee and she was instructed to push it down into the bed (10 repetitions).

To strengthen the hip abductors, the patient was lying in the supine position with flexed knees. I provided pressure in the direction of hip adduction and the patient was instructed to provide counter-pressure in the direction of hip abduction (20 repetitions). To prevent excessive hip adduction, an overball was placed between the patient's knees.

To strengthen the hip adductors, the patient was lying in the supine position with her knees flexed and an overball was placed between them. She was instructed to press the ball (20 repetitions).

To strengthen the gluteus maximus, the patient was lying in the prone position with her knees flexed. I placed my hand on the patient's thigh and asked her to do isometric contraction of the hip extensors. The patient then performed 10 active movements of hip

extension (with her pelvis fixated). An exercise with an overball was also used: the ball was placed under her heel and she was instructed to push the ball down into the bed with her heel (10 repetitions).

6. The patient walked in the corridor and up and down the stairs.

7. To mobilize the scar, I performed c and s-shapes, stretched the scar horizontally and pressed the scar with my thumb.

Result of therapy: The patient cooperated. She reached hip flexion (active, left side) of 70 degrees in today's session. The knee ROM was 105 degrees (active) and 110 degrees (passive). Still occasional instability when walking down the stairs if the patient rushes or is not focused.

Self-therapy: The patient was instructed to perform thromboembolic prevention exercises as many times as she wanted. As usual, she has to keep her legs in a neutral position when lying, and use a protective pillow when getting into the side-lying or sitting position. She has to mind the gait sequence when walking herself (she is advised to have her husband watch over her if she decides to walk down the stairs without me).

Date: Thursday, 11. 2. 2016

Objective status praesens: Today is the 22nd day after surgery.

Subjective status praesens: The patient did not sleep well. The level of pain in the left hip area (VAS) is 2/10. The patient feels pain in the left thigh and has the feeling of heaviness.

Goals of therapy:

1. To prevent thromboembolism

2. To teach the correct breathing pattern

3. To relax the quadriceps muscle on the left side and the hip adductors on the left side

4. To increase the ROM of the left hip (abduction, flexion) and knee (flexion)

5. To strengthen the left rectus femoris, gluteus maximus, hip abductors and adductors.

6. To improve the patient's gait

7. To mobilize the scar

Implementation of therapy

During the therapy session:

1. The patient was in the supine position. She performed flexion and extension of the toes (10 times), dorsiflexion and palmar flexion of the ankles, simultaneously (10 times) and interchangeably (10 times).

2. I placed my hand on the patient's lower abdomen and instructed the patient to breathe under my hand, as if she wanted to push it away from her body with her abdomen, and then breathe out. We repeated the procedure 15 times.

3. To relax and stretch the quadriceps muscle, the patient was in the sitting position. I performed PIR with light stretching (3 repetitions). To relax and stretch the adductors, the patient was in the supine position. I performed PIR with light stretching (3 repetitions).

4. To increase the ROM of the left hip, passive movements with slight stretching were used (up to the pain point); to increase the ROM of the left knee, passive movements with slight stretching and active exercises were used.

Supine position: Hip abduction on the left side – 15 passive movements (ending with a light stretch) in the direction of abduction. Hip flexion on the left side – 5 passive movements (ending with a light stretch) and 10 active movements in the direction of flexion.

Prone position: Knee flexion on the left side - 10 passive movements (ending with a light stretch); 10 active movements.

5. To strengthen the rectus femoris on the left side, the patient was lying in the supine position. She had an overball under her knee and she was instructed to push it down into the bed (10 repetitions).

To strengthen the hip abductors, the patient was lying in the supine position with flexed knees. I provided pressure in the direction of hip adduction and the patient was instructed to provide counter-pressure in the direction of hip abduction (20 repetitions). To prevent excessive hip adduction, an overball was placed between the patient's knees.

To strengthen the hip adductors, the patient was lying in the supine position with her knees flexed and an overball placed between them. She was instructed to press the ball (20 repetitions).

To strengthen the gluteus maximus, the patient was lying in the prone position with her knees flexed. I placed my hand on the patient's thigh and asked her to do isometric contraction of the hip extensors. The patient then performed 10 active movements of the hip extension (with her pelvis fixated). The overball was placed under her heel and she was instructed to push the ball down into the bed with her heel (10 repetitions).

6. The patient walked in the corridor and up and down the stairs.

7. To mobilize the scar, I performed c and s-shapes, stretched the scar horizontally and pressed the scar with my thumb.

Result of therapy: The patient's breathing patter has improved immensely. When she breathes on her own, the abdomen goes up first, followed by the lower thorax and upper thorax. Hip flexion, hip abduction (around 35 degrees today) and knee flexion have all increased.

Self-therapy: The patient was instructed to perform thromboembolic prevention exercises as many times as she wanted. Even when she is at home, she has to keep her legs in a neutral position when lying, and use a protective pillow when getting into the side-lying or sitting position. She has to mind the gait sequence when walking alone and have someone watch over her when she descends the stairs as long as she does not feel completely stable.

Date: Friday, 12. 2. 2016

That morning the patient was dismissed from the hospital. I thanked her for her willingness to be my patient and for her cooperation during the entire period of my clinical practice. Before saying goodbye, we quickly repeated the exercises she would continue to perform at home.

3.6 Final kinesiological examination **(carried out on 11. 2. 2016):**

- Observation
- Postural examination (with the examination of the pelvis in sitting and standing position)
- Gait examination
- Examination of breathing
- Muscle tone examination
- Soft tissue examination (according to Lewit)
- Anthropometric measurements
- ROM examination
- Joint play examination (according to Janda)
- Muscle length tests (according to Janda)
- Muscle strength tests (according to Kendall)
- Examination of movement patterns (according to Janda)
- Neurological examination

3.6.1 Observation: There is no swelling; the scar is clean with only a few small scabs left. There is no swelling in the knee area, but there is still a large haematoma present (in the popliteal fossa and on the lateral side of the proximal calf - but it is smaller and less dark than it was in the beginning). The whole left thigh still looks a bit smaller compared to the right thigh. The same is true of the left calf. There is no swelling in the ankle. Hallux valgus observed on the right LE.

3.6.2 Breathing examination: The patient is lying in the supine position and is instructed to take three deep breaths. On inspiration the upper abdominal fibers are activated first, followed by the lower abdominal fibers and the thoracic area. The patient's breathing pattern has therefore improved, but she still has to work towards activating lower abdominal fibres first.

3.6.3 Postural examination (in the standing position, with French crutches, without loading the operated extremity):

Anterior view

- a narrow base of support

- the feet are somewhat flat on both sides

- the right foot is externally rotated

- the knees are in the neutral position

- the iliac crest is higher on the left side

- the right thoracobrachial triangle is somewhat bigger than the left one

- the right shoulder is slightly elevated

- the head is in a neutral position

- the whole patient is still leaning to the right

Lateral view – left

- the knee is slightly flexed

- the pelvis seems to be in a neutral position, without any tilting

- the spine lacks the characteristic shape (lordosis in the cervical and lumbar areas and kyphosis in the thoracic and sacral areas), the patient exhibits military posture according to Kendall

- the shoulders are slightly protracted (due to the patient standing with crutches)

- the head seems to be in a neutral position

Lateral view – right

- the knee is no longer hyperextended

- the pelvis seems to be in a neutral position

- a lack of lordosis in the cervical and lumbar areas as well as kyphosis in the thoracic and sacral areas

- the shoulders are slightly protracted (due to the patient standing with crutches)

- the head seems to be in the neutral position

Posterior view

- a narrow base of support

- the right foot is slightly externally rotated

- the popliteal fossas are relatively on the same level

- the left subgluteal line is very slightly higher than the right one

- the iliac crest is higher on the left side

- the right thoracobrachial triangle is bigger than the left one

- the right shoulder is higher than the left one

- the head is relatively straight

- the whole patient is leaning to the right

3.6.4 Examination of the pelvis (standing and sitting position):

- the iliac crest is higher on the left side

- the PSIS is higher on the left side

- the ASIS is higher on the left side

- neutral position of the pelvis (in respect to anteversion or retroversion)

3.6.5 Gait examination:

The patient walks with French crutches (three-point gait), without loading the operated limb. Her base of support is rather normal, her walking rhythm non-periodic. The patient loads the foot of the non-operated LE in the correct way, the toe-off phase is present if the patient is focused on it. When her focus shifts to something else, the toe-off phase is absent. The speed of gait is moderate, with good balance. Gait on the stairs is a bit unstable when the patient walks down the stairs and does not pay attention to particular gait sequence (when she wants to do everything very quickly). The position of the trunk has improved, but the patient is still bent forward a small amount. There is still very little movement of the head.

3.6.6 Muscle tone examination (palpation):

Muscle tested	Right side	Left side
quadriceps muscle (rectus femoris, vastus medialis, vastus intermedius, vastus lateralis)	normal	hypertonic (and painful) vastus lateralis and somewhat hypotonic rectus femoris
adductors (add. magnus, add. brevis, add. longus, gracilis, pectineus)	normal	hypertonic (especially the upper fibers of the adductor longus)
iliopsoas	not examined due to sensitivity and pain	not examined due to sensitivity and pain
tensor fasciae latae	normal	normal
erector spinae	normal	normal
quadratus lumborum	normal	normal
gluteus muscles (maximus and medius)	hypotnic (but somewhat less than in the beginning)	hypotonic (but somewhat less than in the beginning)
hamstrings (biceps femoris, semitendinosus, semimembranosus)	normal	normal

Table 14 – Muscle tone examination (palpation)

3.6.7 Soft tissue examination:

1. Superficial layers of the skin on the lower extremities: I didn't find any restrictions on either extremity.

2. Fascia of the lower extremities: The haematoma in the knee area is still present although it is smaller than in the beginning. The patient is still sensitive in that area and examination of the knee fascia is difficult. According to my examination, other fascias of the lower extremities are not restricted.

3. Scar: The scar itself in somewhat restricted but compared to what it was like in the beginning, I can say there has been a big improvement. There are more restrictions in the lower portion of the scar, and there are a few scabs left.

3.6.8 Anthropometric measurement:

Lower extremity	**Right side (cm)**	**Left side (cm)**
anatomical length (greater trochanter – lateral malleolus)	81	(no measurements because of difficulties finding the greater trochanter)
functional length (umbilicus – medial malleolus)	92	92
functional length (ASIS – medial malleolus)	86	86

Table 15 – Anthropometric measurements of the lower extremity – length

Lower extremity	**Right side (cm)**	**Left side (cm)**
thigh (15 cm above the knee – rectus femoris)	44, 5	43
thigh (10 cm above the knee – vastus muscle)	40, 5	38, 5
knee	34	34
calf	32	30
ankle	22	22
foot	21	21

Table 16 – Anthropometric examination of the lower extremity – circumference

3.6.9 ROM examination:

Lower extremity

HIP JOINT				
Plane	Right side		Left side	
	Active movement	Passive movement	Active movement	Passive movement
S	10°-0°-115° (flexed knee)	15°-0°-130° (flexed knee)	5°-0°-85° (flexed knee)	10°-0°-90° (flexed knee)
F	45°-0°-30°	45°-0°-30°	35°-0°-*0°	45°-0°-*0°
R	45°-0°-30°	45°-0°-30°	*0°-0°-*0°	*0°-0°-*0°

Table 17 – ROM (hip joint)

*I did not measure hip adduction, internal and external rotations since these movements are contraindicated after total hip replacement.

KNEE JOINT				
Plane	Right side		Left side	
	Active movement	Passive movement	Active movement	Passive movement
S	0°-0°-125°	0°-0°-125°	0°-0°-110°	0°-0°-120°

Table 18 – ROM (knee joint)

ANKLE JOINT				
Plane	Right side		Left side	
	Active movement	Passive movement	Active movement	Passive movement
S	20°-0°-60°	20°-0°-60°	20°-0°-50°	20°-0°-50°
R	15°-0°-35°	15°-0°-35°	10°-0°-30°	10°-0°-30°

Table 19 – ROM (ankle joint)

3.6.10 Joint play examination according to Lewit:

Joint	Right	Left
patellar joint (medial, lateral, cranial and caudal directions)	not restricted	not restricted
tibiofibular joint (dorsal and ventral directions)	not restricted	restricted in both directions, albeit less painful
talocrural joint (dorsal and ventral directions)	not restricted	not restricted
Lisfranc joint (dorsal and ventral directions)	not restricted	not restricted
Chopart joint (dorsal and ventral directions)	not restricted	not restricted

Table 20 - Joint play examination according to Lewit

3.6.11 Muscle length tests according to Janda

Muscle examined	Right	Left
gastrocnemius and plantaris	0	0
soleus and politeus	0	0
hip adductors	0	1

Table 21 – Muscle length tests according to Janda

3.6.12 Muscle strength tests according to Kendall

Muscle tested	Right	Left
quadriceps femoris	4+	3+
gluteus maximus (prone position, flexed knee)	3	3
gluteus minimus (neutral position)	3	2+
hip adductors (adapted position – supine, isometric contraction only)	4	3+

hamstrings (prone position, flexed knee)	4	4
dorsiflexion of the foot	4+	4
plantar flexion of the foot	4+	4+

Table 22 – Muscle strength tests according to Kendall

3.6.13 Examination of movement patterns according to Janda:

Pattern	Right	Left
hip extension	normal	Hamstrings are activated first, followed by the erector spinae (the left and the right side at approximately the same time). The gluteus maximus is activated last.

Table 23– Examination of movement patterns according to Janda

3.6.14 Neurological examination – sensation:

	Left	Right
L1 dermatome	normal sensation	normal sensation
L2 dermatome	normal sensation	normal sensation
L3 dermatome	normal sensation	normal sensation
L4 dermatome	normal sensation	normal sensation
L5 dermatome	normal sensation	normal sensation
S1 dermatome	normal sensation	normal sensation
S2 dermatome	normal sensation	normal sensation

Table 24 – Neurological examination – sensation

3.6.15 Neurological examination – deep tendon reflexes:

	Right	Left
patellar reflex	2	2
Achilles tendon reflex	1	1

Table 25 – Neurological examination - deep tendon reflexes

3.6.16 Summary of examination:

1. The swelling on the anterior and lateral part of the left thigh as well as around the left knee has disappeared. The scar's mobility has been greatly increased.

2. There are no significant changes in the patient's posture, except for the neutral position of the knee which was hyperextended during the initial examination. The patient has flat feet on both sides and hallux valgus on the left foot. Her right foot is externally rotated. The right thoracobrachial triangle is bigger than the left one. The patient's right shoulder is a bit elevated and she is leaning to the right. She has military posture according to Kendall.

3. The patient's gait is non-periodic, with normal base of support. The loading of the foot (on the non-operated side) is correct. However, if the patient is not paying attention, the toe-off phase is missing. The speed is moderate, the balance is very good on flat surfaces but the patient sometimes struggles when descending the stairs. The patient walks with French crutches (three-point gait).

4. The patient exhibits abdominal breathing patter, with upper abdominal fibres being activated before the lower ones.

5. The examination of the muscle tone (palpation) revealed hypertone and pain in the vastus lateralis and some hypotone in the rectus femoris. The upper fibres of the adductor longus are hypertonic. The gluteal muscles on both sides are still hypotonic, although the tone has improved since the initial examination.

6. Antropometric measurements show that the functional length of the left LE is 1 cm longer than that of the right LE (93 cm from umbilicus to medial malleolus; 87 cm ASIS –

medial malleolus). The circumference of the thigh is smaller on the left LE (15 cm above the knee: 43 cm, as opposed to 44, 5 cm on the right side; 10 cm above the knee: 38, 5 cm, as opposed to 40,5 cm on the right side). The right calf is 2 cm bigger than the left calf (32 cm as opposed to 30 cm).

7. The examination of the ROM has revealed the following:

In the hip joint the ROM is generally more limited on the operated side. Hip extention on the left side is 5 degrees active and 10 degrees passive, which is 5 degrees less than normal according to Janda. Flexion is limited, but greatly improved – 85 degrees active and 90 degrees passive. Flexion above 90 degrees is contraindicated. Abduction of the LE is 35 degrees active and 45 degrees passive. Rotations are no longer limited on the non-operated hip (45 degrees external rotation and 30 degrees internal rotation, both active and passive).

In the left knee joint the ROM is limited, but improved. Flexion is 110 degrees active and 120 degrees passive.

As far as the ankle is concerned, the values are unchanged and mostly within the range of the physiological. There is some hypermobility in plantar flexion on the right side. Both active and passive plantar flexion are around 60 degrees. Inversion on the left side is 30 degrees, which shows slight limitation.

8. The examination of joint play has shown that the talofibular joint on the left side is still restricted, although slightly less painful.

9. The muscle length examination has revealed grade 1 shortness of the left adductors.

10. The examination of muscle strength according to Kendall has revealed the following: Grade 4+ has been assigned to the following muscles: the quadriceps femoris on the right side, the muscles responsible for dorsiflexion and plantar flexion of the right foot, the muscles responsible for plantar flexion of the left foot. Grade 4 has been assigned to these muscles: the hamstrings on both sides, the hip adductors on the right side, the muscles responsible for dorsiflexion of the left foot. These muscles have been assigned grade 3+: the quadriceps femoris on the left side, the hip adductors on the left side. These muscles

have been assigned grade 3: the gluteus maximus on both sides, the gluteus minimus on the right side. The gluteus minimus on the left side has been assigned grade 2+.

11. The patient exhibits a faulty movement pattern of the hip extension.

12. The patient's Achilles tendon reflex is less pronounced on both sides (grade 1).

3.6.17 Conclusion of examination:

There is no swelling. The scar's mobility has greatly improved. The patient's posture is unchanged. The balance and speed of the patient's gait are greater than in the beginning, but attention has to be given to the gait down the stairs because balance is still a problem. The breathing pattern is abdominal.

The rectus femoris on the left side and the gluteus maximus on both sides are hypotonic. The left vastus lateralis and the upper fibres of adductor longus are hypertonic.

There is a 1 cm difference between the functional length of the lower extremities (the left side is 1 cm longer). The left thigh is 1, 5 (15 cm above the knee) and 2 cm (10 cm above the knee) smaller in circumference than the right thigh. The right calf is 2 cm bigger than the left calf.

The ROM is still limited in the case of left hip extension (5 degrees less than normal according to Janda) and left knee flexion (5 degrees less than the permissible ROM). Hip abduction is normal on both sides, and rotations are normal on the right side. The ROM of the ankle remains unchanged.

As far as muscle strength is concerned, the weakest muscles are: the gluteus minimus on the left side, the gluteus minimus on the right side and the gluteus maximus on both sides. The quadriceps femoris on the left side and the hip adductors on the left side are also relatively week. The rest of the muscles tested are able to resist moderate or moderate to strong pressure in the anti-gravity position.

The tibiofibular joint is still restricted; mobilization was not possible due to pain and sensitivity. The left adductors are shortened (grade 1 according to Janda).

The patient still exhibits a faulty movement pattern of the hip extension. The patient's Achilles tendon reflex is somewhat less pronounced on both sides (grade 1).

3.7 The effect of therapy

During the time I worked with patient several things improved.

The swelling disappeared, the scar became more mobile and the breathing pattern improved. There were no significant changes in postural and pelvic abnormalities, and that is something that should be addressed during the long-term rehabilitation (however, the pelvic abnormalities may well be just due to the surgery, and will eventually disappear on their own).

The patient's gait likewise improved, but she has to pay attention when descending the stairs and should be accompanied by someone in case she loses balance.

The muscle tone of gluteus maximus muscles improved a small amount but the muscles are still hypotonic.

The ROM was increased in the following joints: HIP/right side: 5 degrees more of flexion, 15 degrees more of abduction, 5 degrees more of adduction – all active; 15 degrees more of active external rotation and 10 degrees more of active internal rotation; 15 degrees more of active abduction and 5 degrees more of passive abduction. HIP/left side: 35 degrees more of active flexion and 30 more of passive flexion, 5 degrees more of active abduction and 5 degrees more of passive abduction. KNEE/right: 15 degrees more of active flexion, 15 degrees more of passive flexion. KNEE/left: 20 degrees more of active flexion and 20 degrees more of passive flexion.

The tibiofibular joint on the left LE has normal joint play. The left adductors are less shortened.

The following muscles gained strength: the quadriceps femoris on both sides, the gluteus maximus on the left side, the hamstrings on the left side, the muscles responsible for plantar flexion of the foot on the left side.

3.8 Reflexion on therapy

After my clinical practice was over and my patient's therapy concluded, I had an opportunity to reflect on what I could have done differently in order to achieve greater progress in the rehabilitation of my patient.

Although the iliopsoas muscle is usually shortened and hypertonic in patients with coxarthrosis, I did not perform PIR or stretching because my patient was not feeling comfortable in the position I wanted her to be in. The position in question is the testing position for muscle shortness according to Lewit. I was unaware of the possibility to do PIR and stretching of the iliopsoas muscle in the side-lying or prone position. That is certainly something I would do with another patient who has undergone a total hip replacement surgery.

Because my patient was not allowed to load her operated extremity and because the implant created a slight difference in the length of the lower extremities, her quadratus lumborum on the left side was probably hypertonic or/and shortened. I could have examined it and in case the hypertone or shortness was discovered, treated it. A PNF relaxation technique or PIR and stretching could have been used. PNF should be performed in the side-lying position, with a protective pillow between the patient's legs. PIR and stretching could be performed in a sitting position, in order to avoid hip adduction which is very commonly required in the positions which are supine. The soft tissue techniques for thoracolumbar fascia would be useful as well.

Lastly, I could have asked my patient to do more active hip abduction exercises, preferably in the side-lying (anti-gravity) position. That would have strengthened the muscles even more than isometric exercises only. I could have added more exercises for the gluteus

maximus on both sides, as these muscles were quite weak and did not improve as much as I hoped they would.

3.9 Conclusion

After her rehabilitation is fully completed, the patient will be able to resume all of ADLs. Even in eight days she made progress and that is likely to continue. In April she will undergo spa rehabilitation. There are several things that should be addressed during the long-term rehabilitation, especially postural and pelvic irregularities (if the latter persist), flat feet, halux valgus, muscle hypo- and hypertrophy, muscle weakness and restricted ROM. Also the restriction of the left tibiofibular joint should be treated as soon as the haematoma is gone and the area is no longer sensitive.

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5. Supplements

5.1 Supplement 1 – List of tables

Table 1 – Range of motion of the hip joint

Table 2 – Muscle tone examination (palpation)

Table 3 – Anthropometric measurements of the lower extremity – length

Table 4 – Anthropometric measurements of the lower extremity – circumference

Table 5 – ROM (hip joint)

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Table 14 – Muscle tone examination (palpation)

Table 15 – Anthropometric measurements of the lower extremity – length

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Table 17 – ROM (hip joint)

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Table 19 – ROM (ankle joint)

Table 20 - Joint play examination according to Lewit

Table 21 – Muscle length tests according to Janda

Table 22 – Muscle strength tests according to Kendall

Table 23– Examination of movement patterns according to Janda

Table 24 – Neurological examination – sensation

Table 25 – Neurological examination- deep tendon reflexes

5.2 Supplement 2 – List of figures

Figure 1 – Bony pelvis viewed from the front (Singh, 2009, p. 57)

Figure 2 - Ligaments of the hip joint (Putz & Pabst, 2008. p. 537)

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Figure 8 – Materials used for hip replacement implants (Fary, 2014)

5.3 Supplement 3 – List of abbreviations

ASIS – anterior superior iliac spine

ADL (plural ADLs) – activity of daily living

AIIS – anterior inferior iliac spine

DVT – deep vein thrombosis

I - insertion

LE – lower extremity

O - origin

OA - osteoarthritis

PIR – post isometric relaxation

PSIS – posterior superior iliac spine

ROM – range of motion

5.4 Supplement 4 – Informed consent

INFORMOVANÝ SOUHLAS

Vážená paní, vážený pane,

v souladu se Všeobecnou deklarací lidských práv, zákonem č. 101/2000 Sb., o ochraně osobních údajů a o změně některých zákonů, ve znění pozdějších předpisů, Helsinskou deklarací, přijatou 18. Světovým zdravotnickým shromážděním v roce 1964 ve znění pozdějších změn (Fortaleza, Brazílie, 2013) a dalšími obecně závaznými právními předpisy Vás žádám o souhlas s prezentováním a uveřejněním výsledků vyšetření a průběhu terapie prováděné v rámci praxe na ……., kde Vás příslušně kvalifikovaná osoba seznámila s Vaším vyšetřením a následnou terapií. Výsledky Vašeho vyšetření a průběh Vaší terapie bude publikován v rámci bakalářské práce na UK FTVS, s názvem ……

Cílem této bakalářské práce je …….....

Získané údaje, fotodokumentace, průběh a výsledky terapie budou uveřejněny v bakalářské práci v anonymizované podobě. Osobní data nebudou uvedena a budou uchována v anonymní podobě. V maximální možné míře zabezpečím, aby získaná data nebyla zneužita.

Jméno a příjmení řešitele .....
Podpis:.....

Jméno a příjmení osoby, která provedla poučení.....
Podpis:.....

Prohlašuji a svým níže uvedeným vlastnoručním podpisem potvrzuji, že dobrovolně souhlasím s prezentováním a uveřejněním výsledků vyšetření a průběhu terapie ve výše uvedené bakalářské práci, a že mi osoba, která provedla poučení, osobně vše podrobně vysvětlila, a že jsem měl(a) možnost si řádně a v dostatečném čase zvážit všechny relevantní informace, zeptat se na vše podstatné a že jsem dostal(a) jasné a srozumitelné odpovědi na své dotazy. Byl(a) jsem poučen(a) o právu odmítnout prezentování a uveřejnění výsledků vyšetření a průběhu terapie v bakalářské práci nebo svůj souhlas kdykoli odvolat bez represí, a to písemně zasláním Etické komisi UK FTVS, která bude následně informovat řešitele.

Místo, datum .....

Jméno a příjmení pacienta ..... Podpis pacienta:
.....

Jméno a příjmení zákonného zástupce .....…..

Vztah zákonného zástupce k pacientovi ..... Podpis: .....

5.5 Supplement 5 – UK FTVS Ethics Committe approval

UNIVERZITA KARLOVA V PRAZE
FAKULTA TĚLESNÉ VÝCHOVY A SPORTU
José Martího 31, 162 52 Praha 6-Veleslavín

Application for Approval by UK FTVS Ethics Committee

of a research project, thesis, dissertation or seminar work involving human subjects

The title of a project: Physiotherapeutic treatment after total hip replacement – a case study
Project form: bachelor
Period of realization of the project: February 2016
Applicant: Daniela Popov
Main researcher: Daniela Popov
Co-researcher(s):
Supervisor (in case of student's work): Bc. Charilaos Karaliotas
Financial support:

Project description: Bachelor's thesis case study. Physiotherapeutic methods of examination and therapy applied to a patient with total hip replacement.

Ensuring safety within the research: Non-invasive methods are used. Examination and therapy will be carried out at Revmatolgicky ustav, Praha, under the supervision of Charilaos Karaliotas.

Ethical aspects of the research: The participant is adult and non-vulnerable. All personal data will be anonymised.

Informed Consent: attached

It is a duty of **all participants of the research team** to protect life, health, dignity, integrity, the right to self-determination, privacy and protection of the personal data of all research subjects, and to undertake all possible precautions. Responsibility for the protection of all research subjects lies on the researcher(s) and not on the research subjects themselves, even if they gave their consent to participation in the research. All participants of the research team must take into consideration ethical, legal and regulative norms and standards of research involving human subjects applicable not only in the Czech Republic but also internationally.

I confirm that this project description corresponds to the plan of the project and in case of any change, especially of the methods used in the project, I will inform the UK FTVS Ethics Committee, which may require a re-submission of the application form.

In Prague, 06 February 2016 Applicant's signature:

Approval of UK FTVS Ethics Committee

The Committee: Chair: doc. PhDr. Irena Parry Martínková, Ph.D.
Members: prof. PhDr. Pavel Slepička, DrSc.
doc. MUDr. Jan Heller, CSc.
doc. Ing. Monika Šorfová, Ph.D.
Mgr. Pavel Hrásky, Ph.D.
MUDr. Simona Majorová

The research project was approved by UK FTVS Ethics Committee under the registration number: 059/2016
Date of approval: 8.2.2016

UK FTVS Ethics Committee reviewed the submitted research project and **found no contradictions** with valid principles, regulations and international guidelines for carrying out research involving human subjects.

The applicant has met the necessary requirements for receiving approval of UK FTVS Ethics Committee.

Stamp of UK FTVS

Signature of the Chair of
UK FTVS Ethics Committee

UNIVERZITA KARLOVA v Praze
Fakulta tělesné výchovy a sportu
José Martího 31, 162 52, Praha 6
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